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THE IMPLICATIONS OF COAL DEVELOPMENT  
ON THE ATMOSPHERIC ENVIRONMENT  
AND PLANT ECOSYSTEMS OF SELECTED  
SITES IN WESTERN NORTH DAKOTA

DOCUMENT 3A

BASELINE DATA FOR SELECTED GRASSLAND AND  
WOODLAND COMMUNITIES NEAR STANTON, NORTH DAKOTA

to:  
SURFACE ENVIRONMENT AND MINING  
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AGRICULTURAL EXPERIMENT STATION  
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BASELINE DATA FOR SELECTED GRASSLAND AND WOODLAND COMMUNITIES NEAR  
STANTON, NORTH DAKOTA

by

W.T. Barker, W.C. Whitman, G. Larson, S.J. Rothenberger and D.S. Galitz

Introduction

The Botany Department research on this project involved objective 3 which was to determine the effects of the probable changes in air quality on plant ecosystems. To accomplish this objective two botanical study teams were formed, a field team and the physiological response team. The field team studied representative western North Dakota plant communities looking for evidence of emission-caused plant injuries and obtained baseline data on these representative communities so that future monitoring would be possible to identify possible long-term emission effects. The field team consisted of Drs. W.T. Barker, W.C. Whitman, Mr. Gary Larson and Mr. S.J. Rothenberger.

The physiological response team worked in the laboratory with a series of experiments designed to determine the uptake and effects of heavy metals on selected plants. The physiological response group consisted of Dr. D.S. Galitz and Mr. S.J. Rothenberger. In this final report the field team data will be the basis for document 3A and the physiological response data will be the basis for document 3B.

Several reconnaissance trips were made in May, 1974 to various natural vegetation types in western North Dakota. The Stanton, North Dakota area was chosen as a desirable area for the fieldwork for this study since there are active coal mines, two coal-fired electrical

generating plants (United Power Association and Basin Electric Cooperative), in operation there, with expansion of these facilities presently occurring, and the plant communities in the area are representative of those in other proposed coal development areas in the Northern Great Plains. Five prairie sites and seven woodland sites were selected for study. Figure 1 shows the location of these study sites. These sites were sampled each year 1974, 1975 and 1976. The floristic composition, frequency, density and approximate productivity were taken for these communities.

#### Methods and Materials

The Missouri River Valley in the Stanton area is characterized by the river channel, a broad floodplain, a lower terrace and an upper terrace. The vegetation of the area is dependent upon degree of natural disturbance, degree of disturbance by man and due in large part to the soil moisture relationship from the river channel to the upper terrace. To characterize the vegetation in the vicinity of the United Power Association and Basin Electric Cooperative power plants, natural sites were chosen on the Missouri River floodplain, on the terrace directly above the floodplain, and on the upper terrace bordering the river valley. Both native prairie and woodland sites were selected. The availability of such sites <sup>was</sup> were limited because of disturbance by agricultural practices and cattle grazing over most of the region. An attempt was made to locate the study sites at regular distances northwest and southwest of the power plants in the path of the prevailing winds. All sites were located west or south of the river, since emissions from the lignite-burning power plants would likely be most concentrated on the same side



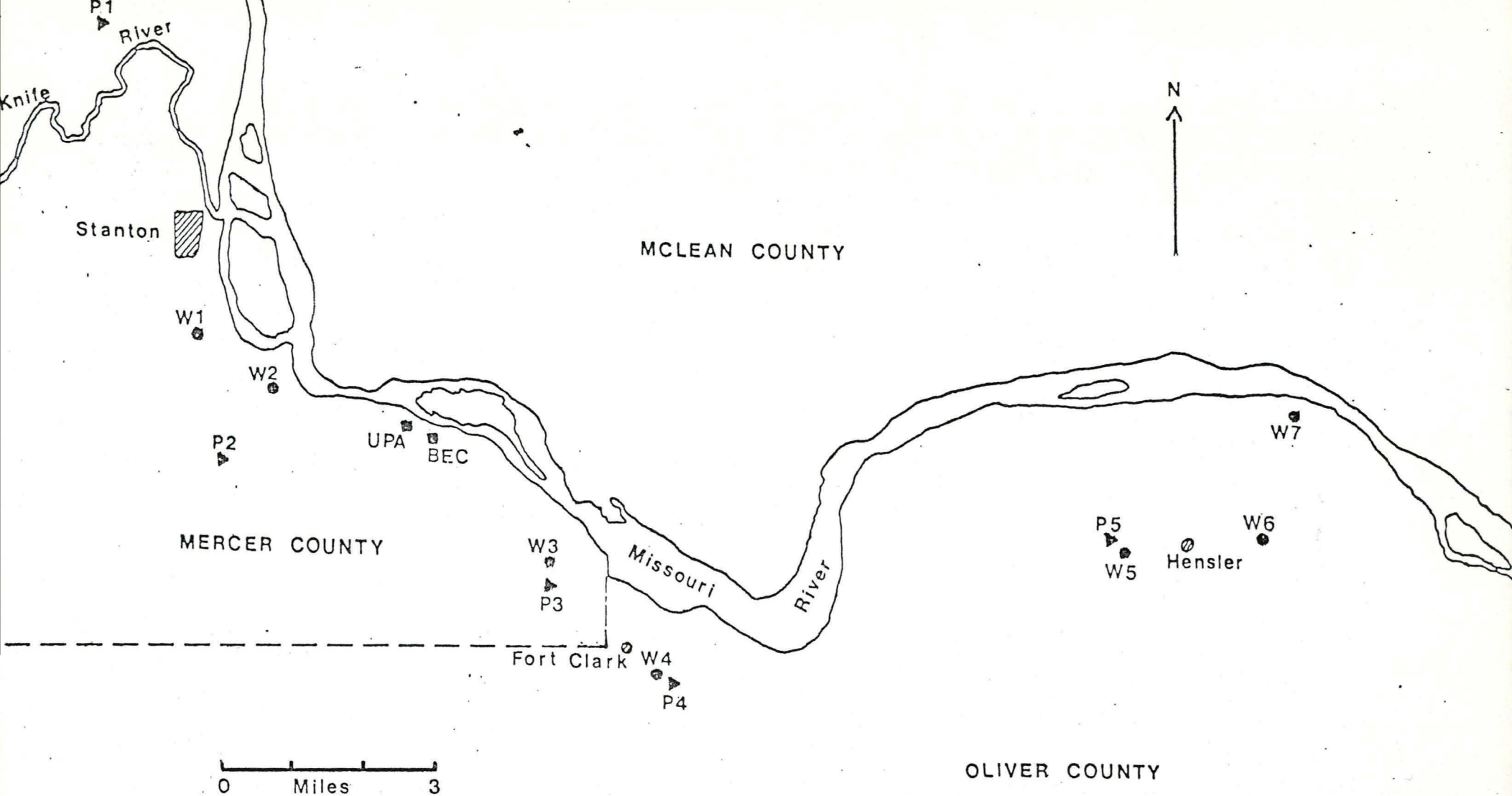


Figure 1. The general location of all extensively sampled prairie and woodland sites.  
 ( P - prairie; W - woodland; BEC - Basin Electric Cooperative; UPA-- United Power Association)

of the river as the smoke stacks. Also, the prevailing south winds of summer and the northwest winds during the rest of the year would frequently carry emissions over the sites. Comparable sites were also selected in the Hensler area, about 15 miles to the east, as a means of comparing the vegetation around the power stations which are frequently exposed to emissions to that away from the plants which was exposed much less to the plant emissions.

All prairie sites, except one, were situated on the terrace bordering the river valley. The exception is the prairie site on the Fort Clark Historic Site, which lies on the lower terrace directly above the floodplain. Two plots were staked out at each site except on the Fort Clark Historic Site, where only one plot was needed because of the uniformity of the vegetation. Three plots were located at a comparable site near Hensler. At each site on the upper terrace near the power plants, one plot was placed on top of the terrace and the second on the slope to enable sampling of both upland and hillside prairie vegetation. All plots were square measuring 25 feet to a side. The points analysis method was employed to estimate percent basal cover of graminoid species. Ten equally spaced line transects were made across each plot, and the point frame, holding ten points, was placed at ten regular intervals along each transect for a total of 1,000 points sampled per plot. Forbs were sampled using 25 randomly placed square foot quadrats. A coordinate system with 10 units on each side of the plot was devised to locate quadrat sampling coordinates. Density, frequency, and relative density of forb species were calculated for each plot. During each growing season agronomy cages were placed on each prairie site to prevent grazing or



mowing. A rectangular frame equivalent to a square meter was used and the vegetation clipped at the soil surface and placed in paper bags. These samples were oven-dried and the lbs. per acre of vegetation was calculated to compare yields of the prairie sites.

The woodland sites were of three types: floodplain gallery woods, woods on the slopes of the lower terrace, and wooded draws in the face of the upper terrace. Sites for comparison were also sampled near Hensler. A rectangular stand measuring 50 x 200 ft. was designated for sampling at each woodland site, except the first, where a 100 x 200 ft. stand was sampled. A modified linestrip method was used for sampling trees and shrubs. The line transects ran the length of each stand separated by 10 feet intervals. The sampling strips were centered on the line transects and measured six feet wide. Within each strip, trees and shrubs of breast height and taller were counted. For shrubs having multiple branches from the base, each branch was counted. The diameter at breast height (d.b.h.) was measured for trees of 2 inches and greater d.b.h. in order to obtain dominance. Trees which were over halfway outside of the strip were not counted. The understory was sampled with a meter square quadrat at four locations along each transect. The sample locations were determined by partitioning the transects into four equal segments and randomly selecting a point along each segment on which to center the quadrat. If a tree interfered with placing the quadrat, a different point was selected. The resultant data was transformed to density, frequency, and relative density for understory species.

The prairie sites were sampled first each of the three years followed by woodland site sampling. The vegetation sampling began each year on

June 15 and usually was completed by July 10. A brief description of the study sites follows.

#### Prairie Site Descriptions

Prairie Site 1. SE $\frac{1}{4}$ , Sec. 20, R84W, T145N: This sampling site is located on the low terrace marking the northern boundary of the Knife River Valley. The terrace hillside faces southeast toward the two power plants. Due to sandy soil, exposure to direct solar radiation, and efficient drainage, this site was the first to show the effects of summer drought in 1974. The prairie at this site was mowed for hay late in the summer of 1974 but remained undisturbed in 1975 and 1976.

Prairie Site 2. SW $\frac{1}{4}$ , Sec. 20, R84W, T144N: This site is situated west of the power plants along the upper terrace overlooking the Missouri River Valley. The terrace faces eastward at this location. The prairie was heavily grazed by cattle during 1974, 1975 and 1976 so that aerial foliage cover was much reduced. The ground was slightly compacted from trampling by cattle.

Prairie Site 3. NW $\frac{1}{4}$ , Sec. 36, R84W, T144N: The site is situated on the prairie terrace directly above the Missouri River floodplain and lies southeast of the power plants. The prairie was largely undisturbed and obviously the most productive of all the prairie sites. Mowing had been practiced over the entire area in previous years, but no mowing was done in the vicinity of the site during 1974, 1975 and 1976.

Prairie Site 4. SE $\frac{1}{4}$ , Sec. 6, R83W, T143N: This site is located on the upper terrace along the Missouri River Valley, and at this location the



terrace faces northward corresponding to an eastward turn of the river course. The power plants are northwest of the site. The prairie, although grazed lightly in previous years, was virtually undisturbed in 1974, 1975 and 1976.

Prairie Site 5. SW $\frac{1}{4}$ , Sec. 29, R82W, T144N: This site was established to serve as comparisons to the prairie sites near the power plants. The terrace along the river was rather irregular at this point, so that a variety of exposures was possible. This site had been subjected to some grazing in the past, but apparently no grazing occurred in 1974-1976.

#### Woodland Site Descriptions

Woodland Site 1. NE $\frac{1}{4}$ , Sec. 18, R84W, T144N: The site is located on the level Missouri River floodplain northwest of the power plants. The woodland stand features an open canopy of old cottonwood trees with a lower stratum of scattered young green ash and a few boxelder. The stand is bordered on the east by cleared cropland and on the west by a branch of the Knife River.

Woodland Site 2. SW $\frac{1}{4}$ , Sec. 17, R84W, T144N: The location is northwest of the power plants along the first terrace above the floodplain. The stand runs along the northeast-facing slope of the terrace and its base. At the bottom of the terrace, the stand is bordered by cropland, and at the top a railroad track skirts the edge of the terrace. Cottonwoods form the thin overstory along with a few old peach-leaved willows. Green ash, boxelder, and an occasional Russian olive form a second stratum. The shrub layer is especially dense at the base of the terrace where red

osier dogwood is dominant. Juneberry and chokecherry become more abundant toward the upper part of the terrace slope.

Woodland Site 3. NW $\frac{1}{4}$ , Sec. 36, R84W, T144N: This site is located on the Fort Clark Historic Site southeast of the power plants. The stand covers a portion of the rather steep north-facing slope of the terrace rising above the Missouri River floodplain. At the base of the terrace, the stand is dominated by a few large cottonwood trees with a lower stratum of young green ash and boxelder. The slope is predominately green ash with a few boxelder and American elm. In the shrub layer, Juneberry, chokecherry, and wolfberry become increasingly abundant up the slope, whereas red osier dogwood is dominant at the terrace base. Due to its north exposure, this site is the most mesic of the woodland sites. Some interesting species occurring in the stand include Cystopteris fragilis (fragile fern), Aquilegia canadensis (prairie columbine) and Oryzopsis micrantha (little ricegrass).

Woodland Site 4. SE $\frac{1}{4}$ , Sec. 6, R83W, T143N: This site is on the upper terrace along the Missouri River Valley. The stand is situated in a steep wooded draw in a northeast-facing portion of the terrace. The two power plants are northwest of the terrace at this site. The stand is nearly open in parts, consisting mostly of small green ash. Two large cottonwoods are prominent in the center of the draw, and one large American elm occurs among the ash at the base of the slope. Shrubs are most abundant at the edges and in the open areas of the wooded draw and they include buffaloberry, Juneberry, chokecherry, wolfberry, common juniper, and skunkbush.



Woodland Site 5. NW $\frac{1}{4}$ , Sec. 32, R82W, T144N: This site and the two following were chosen to compare to the sites near the power plants. The upper terrace overlooking the valley had no significant wooded draws in this vicinity, so a site was chosen in the hills a small distance south of the river valley. The draw is on a northwest slope of a hillside. Dominant trees include green ash and American elm. Chokecherry and Juneberry dominate the shrub stratum and are especially thick along the upper margin of the wooded slope. Wolfberry and Woods rose are also quite common.

Woodland Site 6. SE $\frac{1}{4}$ , Sec. 28, R82W, T144N: The terrace along the river floodplain faces northeast at this point and is further away from the river than the site at the Fort Clark Historic Site. The stand is dominated by an abundance of green ash and boxelder. At the base of the slope the stand contains a number of small trees of the buckthorn, Rhamnus davurica, apparently an escapee from shelter belts. The understory was dense throughout, comprised mainly of green ash and boxelder saplings with red osier dogwood, chokecherry and Juneberry intermixed.

Woodland Site 7. SW $\frac{1}{4}$ , Sec. 15, R82W, T144N: This site is in open gallery woods on the Missouri River floodplain. Large cottonwoods are dominant with a variably dense understory of young boxelder and green ash. Red osier dogwood is the main shrub species in the understory. Much of the area surrounding the stand has been previously cut.

#### Results and Discussion

A special effort was made throughout this study to detect plant injuries due to emissions from the power plants. None were found. The

mining activity, of course, destroys the landscape and the vegetation as it proceeds. The dusting effect on vegetation from mining operations, especially dust from haul roads, seems to have more effect on the vegetation than emissions, but this effect is very local in occurrence. The mining companies do and should water the haul roads to keep this dusting effect to a minimum. However at this point in time little is known about the long-term effects the emissions will have on the plant communities of the area. The fieldwork on this project was carried out so that baseline data on the communities could be obtained. The sites were marked in such a way that they could be monitored in the future to determine if there were any long-term effects from the emissions.

Tables 1-3 present the percent basal cover of the graminoid species for each of the prairie sites sampled by the points analysis method. Each of the prairie sites as one would expect show their individual variation but in general have a percent basal cover of graminoids from 15.0-29.2 percent. The dominant species are blue grama (Bouteloua gracilis), thread-leaf sedge (Carex filifolia), needle-and-thread (Stipa comata), and western wheatgrass (Agropyron smithii). These are the characteristic dominants of the typical Northern Great Plains mixed grass prairie.

The prairie sites differed mainly in their forb composition. Seventy-three species of forbs and shrubs representing 28 families were encountered in the vegetation sampling. (See appendix table 1.) The relative degree of disturbance of the natural condition probably accounts for much of the variation in diversity encountered on the prairie sites. Tables 4, 5 and 6 give the average number of plants per square

Table 1. Percent basal cover of graminoid species from the prairie sites sampled by the points analysis method - 1974 season.

Species	Prairie Sites				
	1	2	3	4	5
<i>Agrohordeum macounii</i>					.50
<i>Agropyron smithii</i>	.85	1.25	.90	.80	
<i>Andropogon gerardi</i>		.10		.05	
<i>Andropogon scoparius</i>				.45	.12
<i>Bouteloua curtipendula</i>					.42
<i>Bouteloua gracilis</i>	5.20	10.50	9.30	5.65	6.27
<i>Calamagrostis montanensis</i>		.35			
<i>Carex eleocharis</i>	.10				.10
<i>Carex filifolia</i>	10.55	7.35	1.40	6.20	4.03
<i>Carex heliophila</i>		1.30			
<i>Koeleria pyramidata</i>	.10	1.50	.10	.10	.43
<i>Stipa comata</i>	3.40	1.15	11.00	5.25	4.67
<i>Stipa viridula</i>				.05	1.13
Miscellaneous species	.80	1.05	.10	.25	.97
Total Basal Cover	21.0	24.55	22.80	18.80	18.64
Bare Ground	79.0	74.45	77.20	82.20	81.36



Table 2. Percent basal cover of graminoid species from the prairie sites sampled by the points analysis method - 1975 season.

Species	Prairie Sites				
	1	2	3	4	5
<i>Agrohordeum macounii</i>			.45		.50
<i>Agrophyron smithii</i>	2.45	1.10	1.40	1.40	
<i>Andropogon scoparius</i>			.15		.13
<i>Aristida longiseta</i>			.05		.03
<i>Bouteloua curtipendula</i>					.43
<i>Bouteloua gracilis</i>	2.40	10.05	3.80	5.10	5.90
<i>Carex filifolia</i>	7.30	6.55	5.70	3.80	5.33
<i>Carex heliophila</i>		1.50		.20	.37
<i>Koeleria pyramidata</i>	.15		.25	.90	.60
<i>Stipa comata</i>	4.15	.30	2.45	8.10	3.37
<i>Stipa viridula</i>		.45			.90
Miscellaneous species	1.35	.65	.80	.30	.47
Total Basal Cover	17.80	20.60	15.05	19.80	18.03
Bare Ground	82.20	79.40	84.95	80.20	81.97

Table 3. Percent basal cover of graminoid species sampled by the points analysis method - 1976 season.

Species	Prairie Sites				
	1	2	3	4	5
<i>Agrohordeum macounii</i>	-	-	-	-	1.1
<i>Agropyron smithii</i>	1.8	0.4	-	1.9	-
<i>Andropogon scoparius</i>	-	-	-	-	1.5
<i>Bouteloua curtipendula</i>	-	-	-	-	2.3
<i>Bouteloua gracilis</i>	1.1	17.3	7.8	6.9	2.6
<i>Carex filifolia</i>	12.5	9.5	2.0	7.5	3.0
<i>Carex heliophila</i>	0.4	0.2	-	-	0.4
<i>Koeleria pyramidata</i>	0.3	-	1.1	0.1	0.4
<i>Muhlenbergia cuspidata</i>	-	-	-	0.3	0.3
<i>Poa secunda</i>	0.1	-	-	-	-
<i>Stipa comata</i>	-	1.3	8.6	2.8	3.4
<i>Stipa viridula</i>	-	-	-	-	0.4
Misc. spp.	0.6	0.5	0.2	-	0.3
Total	19.7	29.2	19.7	19.5	15.7
Bare Ground	80.3	70.8	80.3	80.5	84.3

Table 4. Average number of plants, percent frequency and percent relative density of the forb species in each 1-ft.<sup>2</sup> in the Prairie sites - 1974 season.

Species	Prairie Sites														
	1			2			3			4			5		
	Ave. No. of plants ft.	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft.	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft.	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft.	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft.	Ave. freq. %	Ave. rel. den. %
Agoseris glauca				0.02	2.00	0.08									
Allium textile				0.02	2.00	0.08									
Ambrosia artemisiifolia	0.04	4.00	0.36												
Anemone patens										0.14	12.00	2.66	0.15	14.7	1.32
Arabis holboellii	0.26	12.00	2.08												
Artemisia absinthium													0.01	1.3	0.12
Artemisia campestris	.02	2.00	0.18												
Artemisia frigida	1.50	20.00	13.34	3.06	50.00	21.25				2.88	52.00	35.09	4.16	50.67	23.8
Aster ericoides	1.92	48.00	16.08	3.02	58.00	40.35	0.48	16.00	9.92	1.18	36.00	25.87	.93	24.00	8.2
Camelina microcarpa	0.06	2.00	0.54												
Castilleja sessiliflora	0.04	4.00	0.32												
Ceratoides lanata													0.60	22.67	11.90
Chenopodium leptophyllum				0.26	12.00	2.04							0.07	4.00	1.32
Cirsium undulatum													0.01	1.33	0.12
Collomia linearis				0.46	26.00	1.86									
Echinacea angustifolia				0.04	2.00	0.16				0.10	10.00	0.78	0.12	6.67	1.23
Erigeron glabellus				0.16	10.00	0.65				0.02	2.00	0.16			
Erysium asperum				0.20	12.00	1.57									
Gaura coccinea	0.13	4.00	1.02	0.08	2.00	0.63	0.20	20.00	4.13				0.03	1.33	0.24
Grindelia squarrosa				0.74	16.00	3.14				0.24	8.00	1.89	1.16	14.67	10.47
Gutierrezia sarothrae													0.05	2.67	0.48
Haplopappus spinulosus				0.16	6.00	1.26				0.12	6.00	0.95	0.64	9.33	3.55
Hedeoma hispida	4.34	78.00	36.29	1.24	40.00	5.39	1.24	16.00	25.62				0.23	6.67	4.50
Helianthus petiolaris				0.02	2.00	0.16									
Lactuca oblongifolius	0.10	8.00	0.89	0.08	6.00	0.40	1.08	56.00	22.31	0.04	4.00	0.83			
Lappula redowskii	0.12	6.00	0.96	0.16	8.00	0.65									
Lepidium densiflorum	1.5	50.00	12.40	0.84	40.00	4.31	0.20	16.00	4.13				0.07	4.00	1.32
Lesquerella arenosa				0.02	2.00	0.16							0.01	1.33	0.26



Table 4, continued.

Species	Prairie Sites														
	1			2			3			4			5		
	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %
<i>Liatris punctata</i>	0.08	6.00	0.71	0.02	2.00	0.16				0.24	10.00	1.88	0.45	20.00	3.77
<i>Linum rigidum</i>	0.04	4.00	0.34	0.06	6.00	0.47	0.12	12.00	2.48	0.02	2.00	0.16	0.43	24.00	2.90
<i>Lithospermum incisum</i>				0.06	2.00	.47							0.01	1.33	0.26
<i>Lomatium foeniculaceum</i>				0.02	2.00	0.08									
<i>Lygodesmia juncea</i>	0.28	18.00	2.47				0.12	12.00	2.48						
<i>Medicago sativa</i>							0.88	16.00	18.18						
<i>Orthocarpus luteus</i>				0.72	12.00	2.91				0.10	8.00	0.78	0.12	5.33	1.08
<i>Paronychia sessiliflora</i>										0.06	6.00	0.47	0.08	5.33	1.05
<i>Petalostemum purpureum</i>													0.04	2.67	0.36
<i>Phlox hoodii</i>				0.06	2.00	0.24									
<i>Plantago patagonica</i>				6.06	52.00	24.78									
<i>Polygala alba</i>	0.10	2.00	0.80	0.34	12.00	2.44	0.16	4.00	3.31	0.74	22.00	8.93	0.36	13.13	4.56
<i>Potentilla pensylvanica</i>													0.05	5.33	0.48
<i>Psoralea argophylla</i>	0.16	10.00	1.41	0.32	20.00	1.29	0.36	36.00	7.44						
<i>Psoralea esculenta</i>													0.04	2.67	0.84
<i>Ratibida columnifera</i>				0.20	12.00	1.27				0.16	12.00	1.26			
<i>Senecio plattensis</i>										0.02	2.00	0.16			
<i>Solidago missouriensis</i>													0.01	1.33	0.26
<i>Solidago mollis</i>										0.02	2.00	0.16			
<i>Solidago rigida</i>													0.05	1.33	0.48
<i>Sphaeralcea coccinea</i>				0.14	8.00	1.02							1.57	45.33	12.35
<i>Taraxacum officinale</i>				0.02	2.00	0.16									
<i>Tragopogon dubius</i>	0.52	26.00	4.30	0.04	4.00	0.32				0.02	2.00	0.16	0.01	1.33	0.12
<i>Vicia americana</i>				0.12	6.00	0.49				0.16	10.00	4.88	0.63	10.67	3.10
<i>Viola nuttallii</i>	0.02	2.00	0.18												

Table 5. Average number of plants, percent frequency and percent relative density of forb species in each 1 ft.<sup>2</sup> of the Prairie sites. - 1975 season.

Species	1			2			3			4			5		
	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %
<i>Achillea millefolium</i>							.08	4.00	1.09						
<i>Agoseris glauca</i>				.02	2.00	.04									
<i>Allium textile</i>				.04	4.00	.09				.12	6.00	1.02			
<i>Androsace occidentalis</i>				.02	2.00	.04									
<i>Anemone patens</i>										.16	16.00	1.37	.21	14.66	1.09
<i>Arabis holboellii</i>	1.34	50.0	11.42							.16	8.00	1.37			
<i>Artemisia absinthium</i>													.03	2.66	.13
<i>Artemisia dracunculus</i>	.08	2.0	.68	2.42	50.00	5.28				1.06	34.00	9.08	.29	6.66	1.50
<i>Artemisia frigida</i>	1.02	30.0	8.6	2.30	44.00	5.01				1.74	72.00	14.90	2.27	74.66	11.64
<i>Asclepias stenophylla</i>	.16	6.0	1.35												
<i>Aster ericoides</i>	.22	10.0	1.87	.06	4.00	.13	.20	4.00	2.73	.50	20.00	4.28	.32	8.00	1.63
<i>Astragalus</i> spp.													.01	1.33	.07
<i>Castilleja sessiliflora</i>	.06	4.0	.51												
<i>Ceratoides lanata</i>													.01	1.33	.07
<i>Chenopodium album</i>				.02	2.00	.04				.02	2.00	.17			
<i>Chenopodium leptophyllum</i>	.18	16.00	1.53	.60	26.00	1.30	.28	20.0	3.82	.02	2.00	.17	.88	25.33	4.52
<i>Cirsium undulatum</i>													.07	2.66	.33
<i>Collomia linearis</i>				.42	20.00	.92									
<i>Coryphantha vivipara</i>				.02	2.00	.04									
<i>Commandra umbellata</i>										.38	8.00	3.25			
<i>Draba nemorosa</i>							.32	16.00	4.37						
<i>Echinacea angustifolia</i>										.34	22.00	2.91	.12	8.00	.61
<i>Euphorbia glyptosperma</i>				.10	6.00	.22									
<i>Gaura coccinea</i>	.08	8.0	.68	.12	10.00	.26									
<i>Grindelia squarrosa</i>				.44	6.00	.96				.60	10.00	5.13	2.40	13.33	12.33
<i>Gutierrezia sarothrae</i>										.04	4.00	.34	.11	6.66	.55
<i>Haplopappus spinulosus</i>				.88	22.00	1.92				.62	14.00	5.31	.12	2.66	.61
<i>Hedeoma hispida</i>	4.72	66.0	40.23	6.68	58.00	14.56	3.12	84.00	42.98	.04	2.00	.34	4.93	29.33	25.36
<i>Helianthus petiolaris</i>				.02	2.00	.04									

Table 5, continued.

Species	1			2			3			4			5		
	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants ft. <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %
<i>Lactuca oblongifolius</i>	.92	30.00	7.82	.10	8.00	.22	1.60	72.00	22.03	.10	10.00	.85	.05	5.44	.27
<i>Lappula redowskii</i>	1.10	24.00	9.36	1.76	22.00	3.33							1.27	25.33	6.52
<i>Lepidium densiflorum</i>	.60	22.00	5.09	3.14	64.00	6.85	.16	16.00	2.18				2.47	34.66	12.68
<i>Lesquerella arenosa</i>													.01	1.33	.07
<i>Liatris punctata</i>										.30	16.00	2.56	.60	28.00	3.07
<i>Linum rigidum</i>				.08	8.00	.17	.12	12.00	1.64				.01	1.33	.07
<i>Lithospermum ihcicum</i>				.20	10.00	.44	.08	4.00	1.09						
<i>Lygodesmia juncea</i>	.26	16.00	2.22				.24	10.00	3.28	.02	2.00	.17	.04	4.00	.20
<i>Melilotus officinalis</i>				.06	4.00	.13				.04	4.00	.34			
<i>Orthocarpus luteus</i>				.10	6.00	.22				3.96	36.00	33.92	1.36	14.66	6.98
<i>Petalostemum purpureum</i>										.04	4.00	.34	.08	5.33	.41
<i>Phlox hoodii</i>	.02	2.00	.17							.52	26.00	4.45	.13	6.66	.69
<i>Plantago patagonica</i>				22.96	68.00	50.06									
<i>Polygala alba</i>				.08	2.00	.17				.30	26.00	2.56	.07	6.66	.33
<i>Polygonum convolvulus</i>													.08	2.66	.41
<i>Potentilla pensylvanica</i>										.04	2.00	.34			
<i>Psoralea argophylla</i>	.16	16.00	1.35	.28	22.00	6.10	.24	20.00	3.28	.08	4.00	.68			
<i>Psoralea esculenta</i>													.08	8.00	.41
<i>Ratibida columnifera</i>	.02	2.00	.17	.04	2.00	.09				.20	10.00	1.71			
<i>Rosa arkansana</i>				.10	6.00	.22									
<i>Senecio plattensis</i>													.01	1.33	.07
<i>Solidago rigida</i>	.10	4.00	.85										.01	1.33	.07
<i>Sphaeralcea coccinea</i>	.02	2.00	.34	.16	12.00	.35							.80	34.66	4.11
<i>Symphoricarpos occidentalis</i>										.06	6.00	.51			
<i>Taraxacum officinale</i>	.04	2.00	.34	.02	2.00	.04	.52	36.00	7.15	.08	6.00	.68			
<i>Tragopogon dubius</i>	.60	40.00	5.09										.03	2.66	.13
<i>Vicia americana</i>				.06	4.00	.13				.14	6.00	1.19	.53	10.66	2.74
<i>Viola nuttallii</i>	.04	4.0	.34	.06	6.00	.13				.02	2.00	.17	.03	2.66	.13



Table 6. Average number of plants, percent frequency and percent relative density of the forb species in each 1 ft.<sup>2</sup> in the Prairie sites - 1976 season.

Species	1			2			3			4			5		
	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %
Androsace occidentalis							0.36	12.00	4.46						
Anemone patens										0.04	4.00	1.72	0.64	48.00	4.61
Arabis hirsuta													0.04	4.00	0.29
Arabis holboellii	1.92	72.00	15.56							0.12	8.00	5.17			
Artemisia caudata	0.52	4.00	4.21	3.20	72.00	44.2									
Artemisia dracunculus										0.60	20.00	25.86	0.76	24.00	5.48
Artemisia frigida	1.80	44.00	14.59	1.92	68.00	26.52				0.28	16.00	12.07	0.84	56.00	6.05
Aster ericoides	0.44	16.00	3.57	0.40	12.00	5.52							1.64	32.00	11.82
Castilleja sessiliflora	0.80	8.00	0.65												
Chenopodium leptophyllum				0.12	4.00	1.66									
Commandra umbellata													0.24	8.00	1.73
Echinacea angustifolia										0.32			0.32	28.00	2.31
Erigeron strigosus							0.04	4.00	0.50						
Gaura coccinea	0.32	12.00	2.59	0.04	4.00	.55									
Grindelia squarrosa				0.20	4.00	2.76							6.96	52.00	50.14
Gutierrezia sarothrae													0.16	12.00	1.15
Haplopappus spinulosus				0.60	32.00	8.29							0.12	8.00	0.86
Hedeoma hispida	4.44	80.00	35.98				0.48	24.00	5.94						
Hedysarum boreale													0.20	4.00	1.44
Lactuca oblongifolius	0.04	4.00	0.32	0.04	4.00	0.55	1.28	60.00	15.84	0.56	36.00	24.14	0.04	4.00	0.29
Lappula redowskii	0.06	32.00	0.49												
Lepidium densiflorum	1.51	52.00	12.32				0.24	12.00	2.97						
Liatris punctata													0.48	32.00	3.46
Linum rigidum				0.04	4.00	0.55									
Lithospermum incisum				0.32	16.00	4.42									
Lygodesmia juncea	0.16	12.00	1.30				0.80	48.00	9.90				0.28	24.00	2.02

Table 6, continued.

Species	1			2			3			4			5		
	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %	Ave. No. of plants ft. <sup>2</sup>	Ave. freq. %	Ave. rel. den. %
Monarda fistulosa										0.08	8.00	3.45			
Penstemon albidus													0.04	4.00	0.29
Petalostemum purpureum													0.24	16.00	1.73
Phlox hoodii													0.12	12.00	0.86
Polygala alba				0.04	4.00	0.55				0.04	4.00	1.72	0.20	16.00	1.44
Potentilla pensylvanica							0.04	4.00	0.40				0.08	4.00	0.58
Psoralea argophylla	0.04	4.00	0.32				0.20	16.00	2.48				0.04	4.00	0.29
Psoralea esculenta													0.12	12.00	0.86
Ratibida columnifera				0.04	4.00	0.55				0.08	4.00	3.45			
Senecio plattensis										0.08	8.00	3.45			
Solidago rigida							0.16	8.00	1.98				0.16	8.00	1.15
Sphaeralcea coccinea	0.08	4.00	0.65	0.24	12.00	3.31				0.04	4.00	1.72			
Taraxacum officinale							1.28	68.00	15.84	0.12	8.00	5.17			
Tragapogon dubius	0.88	44.00	7.13	0.04	4.00	0.55	0.40	24.00	4.95				0.08	8.00	0.58
Vicia americana							2.80	76.00	34.65	0.28	12.00	12.07			
Viola nuttallii	0.04	4.00	0.32										0.08	4.00	0.58

foot, percent frequency and percent relative density of the forb species in the prairie sites. Heath aster (Aster ericoides), narrow-leaf goosefoot (Chenopodium leptophyllum), rough penneyroyal (Hedeoma hispida), wild lettuce (Lactuca oblongifolius), stiffstem flax (Linum rigidum), white milkwort (Polygala alba), silverleaf (Psoralea argophylla), globe mallow (Sphaeralcea coccinea), dandelion (Taraxacum officinale) and goatsbeard (Tragopogon dubius) were found on all five prairie sites. Other plants common to most of the sites were: green sage (Artemisia dracunculus), fringed sage (Artemisia frigida), gaura (Gaura coccinea), peppergrass (Lepidium densiflorum), blazing star (Liatris punctata), skeleton weed (Lygodesmia juncea) and Nuttall's violet (Viola nuttallii).

The comparison of the production of the prairie sites for 1975 and 1976 are given in tables 7 and 8. The production values compare favorably with typical mixed grass prairie sites in the Northern Great Plains. There have been many range studies which characterize Northern Great Plains grasslands in terms of species composition and production. Some of these studies are Albee et al. (1948), Burgess et al. (1973), Colville et al. (1963), Dalrymple and Dwyer (1967), Goetz (1963, 1969, and 1969), Haas and Willis (1971), Houston (1971), Rogler and Haas (1947), Rogler and Lorenz (1957), Smika et al. (1965), and Whitman (1941, 1954 and 1976). The sites studied in this study compare favorably in composition, structure and production with the above studies.

Johnson (1971) and Keammerer (1971) studied the forest overstory vegetation and the forest understory vegetation on the Missouri River Floodplain in North Dakota. Their study involved stands along the Missouri River from Garrison Dam on the north to the Oahe Reservoir



Table 7. Summary of prairie site production in 1975 based upon July 15, 1975 yield clippings taken at soil surface. (Values are expressed in pounds/acre.)

Class of Vegetation	Prairie Site 1	Prairie Site 2	Prairie Site 3	Prairie Site 4	Prairie Site 5
Graminoids	1112.6	762.9	1880.4	774.9	900.3
Forbs	446.2	521.5	346.7	535.8	581.8
Total	1558.8	1284.4	2227.1	1310.7	1482.1

Table 8. Summary of prairie site production in 1976 based upon July 15, 1976 yield clippings taken at soil surface. (Values expressed in pounds/acre.)

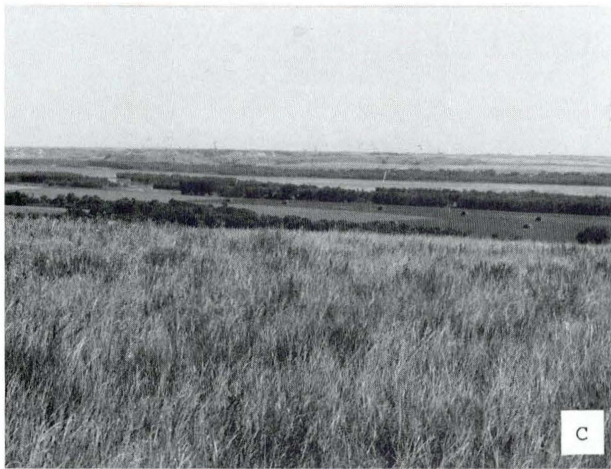
Class of Vegetation	Prairie Site 1	Prairie Site 2	Prairie Site 3	Prairie Site 4	Prairie Site 5
Graminoids	1726.0	1214.9	1123.9	1670.7	1293.4
Forbs	198.1	131.1	227.5	192.7	77.6
Total	1924.1	1346.0	1351.4	1863.4	1371.0

- A. The United Power Association and Basin Electric Cooperative power plants as seen looking east from Prairie Site 2.
- B. The Fort Clark Historic Site located on the level terrace just above the Missouri River floodplain, southeast of the power plants--the location for Prairie Site 3 and Woodland Site 3.
- C. Prairie Site 2 showing the proximity of lignite strip mining just south of the site.
- D. Prairie Site 4--Plot 2, located on the upper terrace slope above the Missouri Valley near Fort Clark.





- A. Woodland Site 1, located south of Stanton on the Missouri River floodplain--an excellent example of cottonwood gallery forest.
- B. Woodland Site 3, located on the lower terrace slope below the Fort Clark Historic Site, showing large cottonwood at the base of the slope and green ash upward on the slope.
- C. The Missouri River floodplain as seen from the upper terrace at Prairie Site 4 near Fort Clark.
- D. Woodland Site 4--a hardwood draw on the northeast-facing slope of the upper terrace above the Missouri Valley near Fort Clark.



on the South. Information gained in the present study tends to bear out their findings. The Missouri River is a wide meandering river which is responsible in large part for the nature of the woodland vegetation in the Missouri River Valley. Many sandbars exist as sediments are deposited and the river meanders. Cottonwoods (Populus deltoides) become established on these sandbars and can develop into cottonwood forests which are characteristic of the immediate floodplain of the river. The Missouri River Valley consists of the floodplain, a lower terrace, and an upper terrace. The lower terrace slope is dominated by green ash (Fraxinus pensylvanica) and boxelder (Acer negundo). The upper terrace slopes are dissected by drainage ways and hardwood vegetation dominated by green ash and buffaloberry (Sheperdia argentea).

Woodland sites 1 and 7 of this study are dominated by cottonwood and are found on the immediate floodplain of the Missouri River. Woodland sites 2, 3 and 6 are on the first terrace slopes of the valley and are dominated by cottonwood and green ash or green ash. Woodland sites 4 and 5 are typical wooded draws found on the upper terrace slopes and are dominated by green ash and buffalo berry. Tables 9-30 give the density of tree species per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland sites for 1974, 1975 and 1976. Data for both trees and shrubs are given in these tables.

Tables 31-33 provide data on the average number of plants, percent frequency, and relative density of forbs, graminoids and seedlings in each square meter in the woodland sites studied in 1974, 1975 and 1976.



Table 9. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 1. - 1974 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	36.30	8.48	40.00	18.18	644.29	3.12	29.78
Fraxinus							
pensylvanica	254.10	59.32	90.00	40.91	1532.26	7.39	107.62
Populus							
deltoides	137.94	32.20	90.00	40.91	18549.19	89.49	162.60
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Elaeagnus							
angustifolia	3.63	33.33	10.00	33.33			
Fraxinus							
pensylvanica	7.26	66.67	20.00	66.67			

Table 10. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants in woodland site no. 2. - 1974 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	94.09	19.28	100.00	29.41	1186.40	3.27	51.96
Elaeagnus							
angustifolia	14.37	2.96	20.00	5.88	463.26	1.28	10.12
Fraxinus							
pensylvanica	130.60	26.78	80.00	23.53	1182.20	3.26	53.57
Populus							
deltoides	139.40	28.64	60.00	17.65	32363.70	89.14	135.43
Prunus							
virginiana	101.50	20.90	60.00	17.65	460.19	1.76	40.31
Salix							
amygdaloides	6.97	1.43	20.00	5.88	472.19	1.30	8.61
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Acer							
negundo	689.50	12.29	100.00	11.90			
Amelanchier							
alnifolia	79.71	1.42	40.00	4.76			
Cornus							
stolonifera	2996.90	53.43	100.00	11.90			
Fraxinus							
pensylvanica	486.12	8.66	100.00	11.90			
Prunus							
virginiana	818.90	14.60	100.00	11.90			
Rosa							
woodsii	50.52	0.90	60.00	7.14			

Table 11. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 3. - 1974 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	87.12	23.08	100.00	38.46	1842.80	5.16	66.70
Fraxinus							
pensylvanica	239.60	63.48	100.00	38.46	3262.80	9.14	110.08
Populus							
deltoides	50.80	13.43	60.00	23.08	30601.80	85.70	122.21
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Acer							
negundo	101.50	6.65	100.00	16.67			
Amelanchier							
alnifolia	217.80	14.26	100.00	16.67			
Cornus							
stolonifera	188.60	12.34	60.00	10.00			
Fraxinus							
pensylvancia	210.40	13.77	100.00	16.67			
Prunus							
virginiana	548.90	35.92	100.00	16.67			
Rosa							
woodsii	137.60	9.01	60.00	10.00			
Symphoricarpos							
occidentalis	115.90	7.58	60.00	10.00			
Ulmus							
americana	7.20	0.47	20.00	3.32			



Table 13. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, present relative dominance and importance value of woody plants on woodland site no. 4. - 1974 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Fraxinus							
pensylvanica	297.50	85.50	100.00	55.58	4683.40	49.11	190.19
Populus							
deltoides	14.50	4.17	20.00	11.10	4024.30	42.20	57.47
Prunus							
virginiana	28.75	8.25	40.00	22.21	150.79	1.58	32.04
Ulmus							
americana	7.23	2.07	20.00	11.10	677.43	7.10	20.27
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Amelanchier							
alnifolia	79.70	11.45	40.00	11.10			
Fraxinus							
pensylvanica	152.50	21.90	80.00	22.22			
Prunus							
virginiana	202.99	29.15	80.00	22.22			
Rhus							
trilobata	14.50	2.09	20.00	5.55			
Rosa							
woodsii	57.90	8.33	40.00	11.10			
Shepherdia							
argentea	188.60	27.09	100.00	27.79			

Table 14. Density per acre, percent relative density, percent frequency, percent relative frequency- dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 5. - 1974 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Fraxinus							
pennsylvanica	580.65	81.63	100.00	45.46	7529.40	83.02	210.11
Prunus							
virginiana	43.56	6.12	40.00	18.17	179.10	1.97	26.26
Ulmus							
americana	87.12	12.24	80.00	36.37	1360.45	15.00	63.61
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Acer							
negundo	21.78	0.73	60.00	11.11			
Amelanchier							
alnifolia	1189.70	39.53	100.00	18.52			
Crataegus							
chrysocarpa	7.23	0.24	20.00	3.70			
Fraxinus							
pennsylvanica	217.80	7.24	100.00	18.52			
Prunus							
americana	21.78	0.72	20.00	3.70			
Prunus							
virginiana	1372.14	45.59	100.00	18.52			
Rosa							
woodsii	143.74	4.77	60.00	11.11			
Symphoricarpos							
occidentalis	28.75	0.95	60.00	11.11			
Viburnum							
lentago	7.23	0.24	20.00	3.70			

Table 15. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 6. - 1974 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Import- tance value
Acer							
negundo	94.38	22.43	80.00	23.53	4130.14	29.17	75.13
Amelanchier							
alnifolia	14.52	3.45	20.00	5.88	52.93	0.37	9.70
Fraxinus							
pensylvanica	268.30	63.77	100.00	29.41	7787.00	55.00	148.18
Prunus							
virginiana	14.52	3.45	40.00	11.76	45.59	0.32	15.53
Ulmus							
americana	21.78	5.18	80.00	23.53	2090.20	14.76	43.47
Vitis							
riparia	7.26	1.72	20.00	5.88	51.33	0.36	7.96

Shrubs and Saplings less than 2 inches d.b.h.

Acer				
negundo	2090.88	50.35	100.00	15.63
Amelanchier				
alnifolia	842.16	20.28	100.00	15.63
Cornus				
stolonifera	58.08	1.39	40.00	6.25
Fraxinus				
pensylvanica	588.06	14.16	100.00	15.63
Prunus				
americana	7.26	.18	20.00	3.13
Prunus				
virginiana	319.44	7.69	100.00	15.63
Rhamnus				
davurica	123.42	2.97	60.00	9.38
Shepherdia				
argentea	7.26	.18	20.00	3.13
Symphoricarpos				
occidentalis	7.26	.18	20.00	3.13
Ulmus				
americana	108.90	2.62	80.00	12.50



Table 16. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 7. - 1974 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Fraxinus pennsylvanica	29.04	12.90	60.00	37.51	179.40	0.84	51.25
Populus deltoides	196.02	87.10	100.00	62.49	21301.78	99.16	248.75
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Acer negundo	820.38	22.47	100.00	22.73			
Cornus stolonifera	929.28	25.44	100.00	22.73			
Fraxinus pennsylvanica	1778.60	48.70	100.00	22.73			
Parthenocissus vitacea	21.78	.60	60.00	13.64			
Rosa woodsii	87.12	2.39	60.00	13.64			
Symphoricarpos occidentalis	14.52	.40	20.00	4.54			

Table 17. Density per acre percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 1. - 1975 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Fraxinus							
pennsylvanica	108.90	61.22	80.00	53.33	1496.07	6.49	121.04
Populus							
deltoides	68.97	38.78	70.00	46.67	21575.90	93.51	178.96
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Eleagnus							
angustifolia	3.63	33.33	10.00	33.33			
Fraxinus							
pennsylvanica	7.26	67.67	20.00	66.66			

Table 18. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 2. - 1975 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer negundo	94.38	18.06	100.00	33.33	1361.47	3.38	54.77
Fraxinus pennsylvanica	217.80	41.67	80.00	26.67	2180.40	5.41	73.75
Populus deltoides	166.98	31.94	60.00	20.00	35958.05	89.20	141.14
Prunus virginiana	36.30	6.94	40.00	13.13	316.54	.79	21.06
Salix amygdaloides	7.26	1.39	20.00	6.67	493.17	1.22	9.28

Shrubs and Saplings less than 2 inches d.b.h.

Acer negundo	740.52	12.32	100.00	20.83
Amelanchier alnifolia	101.64	1.69	40.00	8.33
Cornus stolonifera	3862.32	64.25	100.00	20.83
Fraxinus pennsylvanica	486.42	8.09	100.00	20.83
Lonicera tatarica	7.26	.12	20.00	4.17
Prunus virginiana	791.34	13.17	100.00	20.83
Rosa woodsii	21.78	.36	20.00	4.17



Table 19. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 3. - 1975 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Speices	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	65.34	14.29	80.00	30.77	1368.66	3.96	49.02
Fraxinus							
pensylvanica	341.22	74.60	100.00	38.46	5421.99	15.69	128.75
Populus							
deltoides	43.56	9.52	60.00	23.08	27633.74	79.96	112.56
Ulmus							
americana	7.26	1.59	20.00	7.69	136.92	.39	9.67
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Acer							
negundo	58.08	2.86	100.00	14.71			
Amelanchier							
alnifolia	268.62	13.21	100.00	14.71			
Cornus							
Stolonifera	435.60	21.43	80.00	11.76			
Crataegus							
chrysocarpa	7.26	.36	20.00	2.94			
Fraxinus							
pensylvanica	312.18	15.36	100.00	14.71			
Prunus							
virginiana	660.66	32.50	100.00	14.71			
Rosa							
woodsii	94.38	4.64	40.00	5.88			
Symphoricarpos							
occidentalis	166.98	8.21	80.00	11.76			
Ulmus							
americana	29.04	1.43	60.00	8.82			

Table 20. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 4. - 1975 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Fraxinus							
pennsylvanica	341.22	87.03	100.00	55.56	5081.64	44.48	187.07
Populus							
deltoides	21.78	5.56	20.00	11.11	5531.90	48.43	65.10
Prunus							
virginiana	21.78	5.56	40.00	22.22	94.52	.83	28.61
Ulmus							
americana	7.26	1.85	20.00	11.11	715.26	6.26	19.22

Shrubs and Saplings less than 2 inches d.b.h.

Amelanchier				
alnifolia	188.76	19.40	100.00	18.52
Fraxinus				
pennsylvanica	210.54	21.64	100.00	18.52
Juniperus				
communis	65.34	6.76	60.00	11.11
Prunus				
virginiana	261.36	26.97	100.00	18.52
Rhus				
trilobata	29.04	2.99	20.00	3.70
Rosa				
woodsii	72.60	7.46	40.00	7.41
Shepherdia				
argentea	130.68	13.43	100.00	18.52
Symphoricarpos				
occidentalis	14.52	1.49	20.00	3.70

Table 21. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 5. - 1974 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Fraxinus							
pennsylvanica	660.66	85.04	100.00	45.45	8290.70	86.14	216.65
Prunus							
virginiana	29.04	3.74	40.00	18.18	136.34	1.42	23.34
Ulmus							
americana	87.12	11.21	80.00	36.36	1197.10	12.44	60.01

Shrubs and Saplings Less than 2 inches d.b.h.

Acer							
negundo	14.52	.40	40.00	8.00			
Amelanchier							
alnifolia	1379.40	37.85	100.00	20.00			
Crataegus							
chrysocarpa	7.26	.20	20.00	4.00			
Fraxinus							
pennsylvanica	174.24	4.78	100.00	20.00			
Prunus							
americana	14.52	.40	20.00	4.00			
Prunus							
virginiana	1815.00	49.80	100.00	20.00			
Rosa							
woodsii	196.02	5.38	80.00	16.00			
Symphoricarpos							
occidentalis	43.56	1.19	40.00	8.00			



Table 22. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 6. - 1975 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	65.34	13.85	80.00	26.67	1209.59	7.45	47.97
Amelanchier							
alnifolia	7.26	1.54	20.00	6.66	22.80	.14	8.34
Fraxinus							
pensylvanica	319.44	67.69	80.00	26.67	12490.98	76.93	171.29
Prunus							
virginiana	29.04	6.15	60.00	20.00	218.16	1.34	27.49
Ulmus							
americana	50.82	10.77	60.00	20.00	2295.83	14.14	44.91

Shrubs and Saplings less than 2 inches d.b.h.

Acer				
negundo	2207.04	54.58	100.00	16.13
Amelanchier				
alnifolia	617.10	15.26	100.00	16.13
Cornus				
stolonifera	72.60	1.80	60.00	9.68
Fraxinus				
pensylvanica	551.76	13.64	100.00	16.13
Prunus				
virginiana	319.44	7.90	100.00	16.13
Rhamnus				
davurica	174.24	4.31	60.00	9.68
Ulmus				
americana	94.38	2.33	80.00	12.90
Viburnum				
lentago	7.26	.18	20.00	3.22

Table 23. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 7. - 1975 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Fraxinus							
pennsylvanica	21.78	9.38	40.00	28.57	83.20	.36	38.31
Populus							
deltoides	210.54	90.62	100.00	71.43	23243.18	99.64	261.69

Shrubs and Saplings less than 2 inches d.b.h.

Acer							
negundo	958.32	20.34	100.00	20.00			
Amelanchier							
alnifolia	7.26	.15	20.00	4.00			
Cornus							
stolonifera	805.86	17.10	100.00	20.00			
Fraxinus							
pennsylvanica	2737.02	58.09	100.00	20.00			
Rosa							
woodsii	50.82	1.08	80.00	16.00			
Symphoricarpos							
occidentalis	152.46	3.24	100.00	20.00			

Table 24. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 1 - 1976 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	7.26	4	40	17	569.91	2.67	23.67
Elaeagnus							
angustifolia	7.26	4	40	17	35.65	0.16	21.16
Fraxinus							
pennsylvanica	98.01	55	80	35	1119.86	5.25	95.25
Populus							
deltoides	65.39	37	70	30	19624.14	91.92	158.92

Shrubs and Saplings less than 2 inches d.b.h.

Fraxinus				
pennsylvanica	10.89	100	40	100



Table 25. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 2 - 1976 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	94.38	17.81	100.00	29.41	1273.19	4.34	51.56
Elaeagnus							
angustifolia	14.52	2.74	20.00	5.88	257.95	0.88	9.50
Fraxinus							
pennsylvanica	203.28	38.36	80.00	23.53	20224.24	6.91	68.80
Populus							
deltoides	137.94	26.03	60.00	17.65	24825.35	84.69	128.37
Prunus							
virginiana	72.60	13.70	60.00	17.65	520.76	1.78	33.13
Salix							
amygdaloides	7.26	1.37	20.00	5.88	412.01	1.41	8.67

Shrubs and Saplings less than 2 inches d.b.h.

Acer				
negundo	834.90	14.71	100.00	11.90
Amelanchier				
alnifolia	65.70	1.16	40.00	4.76
Cornus				
stolonifera	3659.04	64.45	100.00	11.90
Fraxinus				
pennsylvanica	370.26	6.51	100.00	11.90
Prunus				
virginiana	711.48	12.53	100.00	11.90
Rosa				
woodsii	36.30	0.64	60.00	7.14

Table 26. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 3. - 1976 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	130.68	27.69	80	33.33	2470.36	6.03	67.05
Fraxinus							
pennsylvanica	275.88	58.45	100	41.67	4654.38	11.37	111.50
Populus							
deltoides	65.34	13.85	60	25.00	33814.32	82.60	121.45
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Acer							
negundo	108.90	5.02	100	14.29			
Amelanchier							
alnifolia	261.36	12.04	100	14.29			
Cornus							
stolonifera	348.48	16.05	80	11.43			
Fraxinus							
pennsylvanica	406.56	18.73	100	14.29			
Prunus							
virginiana	675.18	31.10	100	14.29			
Rosa							
woodsii	101.64	4.68	40	5.71			
Symphoricarpos							
occidentalis	203.28	9.36	80	11.43			
Ulmus							
americana	21.78	1.00	60	8.57			
Viburnum							
lentago	43.56	2.01	40	5.71			

Table 27. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 4. - 1976 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi-nance per Acre	Rel. Domi-nance %	Impor-tance value
Fraxinus							
pennsylvanica	406.56	87.50	100	55.56	6175.57	45.33	188.34
Populus							
deltoides	21.74	4.69	20	11.11	6581.92	48.31	64.11
Prunus							
virginiana	29.04	6.25	40	22.22	111.51	0.82	29.29
Ulmus							
americana	7.26	1.56	20	11.11	754.09	5.54	18.21

Shrubs and Saplings less than 2 inches d.b.h.

Amelanchier				
alnifolia	152.46	11.41	100	19.23
Fraxinus				
pennsylvanica	344.22	25.54	100	19.23
Juniperus				
communis	14.52	1.09	60	11.54
Prunus				
virginiana	399.30	29.89	100	19.23
Rhus				
trilobata	43.56	3.26	20	3.85
Rosa				
woodsii	159.72	11.96	40	7.69
Shepherdia				
argentea	225.06	16.85	100	19.23



Table 28. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 5. - 1976 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Fraxinus							
pennsylvanica	871.25	83.92	100	45.45	10092.53	83.89	213.26
Prunus							
virginiana	50.83	4.90	40	18.18	213.16	1.77	24.85
Ulmus							
americana	116.17	11.19	80	36.36	1724.79	14.34	61.89
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Acer							
negundo	36.31	0.95	40	7.69			
Amelanchier							
alnifolia	1481.13	38.71	100	19.23			
Crataegus							
chrysocarpa	7.26	0.19	20	3.85			
Fraxinus							
pennsylvanica	423.34	11.20	100	19.23			
Prunus							
americana	50.82	1.33	20	3.85			
Prunus							
virginiana	1618.98	42.31	100	19.23			
Rosa							
woodsii	159.72	4.17	80	15.38			
Symphoricarpos							
occidentalis	29.04	0.76	40	7.69			
Ulmus							
americana	14.52	0.38	20	3.85			

Table 29. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 6. - 1976 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	79.86	14.86	80	26.67	1481.76	8.65	50.18
Amelanchier							
alnifolia	21.78	4.05	20	6.66	68.39	0.40	11.11
Fraxinus							
pennsylvanica	355.74	66.22	80	26.67	12868.71	75.15	168.04
Prunus							
virginiana	43.56	8.11	60	20.00	538.69	3.15	31.26
Ulmus							
americana	36.30	6.76	60	20.00	2165.37	12.65	39.41

Shrubs and Saplings less than 2 inches d.b.h.

Acer				
negundo	2570.04	54.13	100	16.13
Amelanchier				
alnifolia	820.38	17.28	100	16.13
Cornus				
stolonifera	87.12	1.83	60	9.68
Fraxinus				
pennsylvanica	631.62	13.30	100	16.13
Prunus				
virginiana	377.52	7.95	100	16.13
Rhamnus				
davurica	166.98	3.52	60	9.68
Ulmus				
american	87.12	1.83	80	12.90
Viburnum				
lentago	7.26	0.15	20	3.22

Table 30. Density per acre, percent relative density, percent frequency, percent relative frequency, dominance per acre, percent relative dominance and importance value of woody plants on woodland site no. 7. - 1976 growing season.

<u>Trees greater than 2 inches d.b.h. (diameter at breast height)</u>							
Species	Density per Acre	Rel. Density %	Freq. %	Rel. Freq. %	Domi- nance per Acre	Rel. Domi- nance %	Impor- tance value
Acer							
negundo	14.52	6.66	20	12.50	45.59	0.20	19.36
Fraxinus							
pennsylvanica	43.56	20.00	40	25.00	297.66	1.33	46.33
Populus							
deltoides	159.72	73.33	100	62.50	21973.77	98.46	234.29
<u>Shrubs and Saplings less than 2 inches d.b.h.</u>							
Acer							
negundo	914.76	21.32	100	19.23			
Cornus							
stolonifera	871.20	20.30	100	19.23			
Fraxinus							
pennsylvanica	2257.86	52.63	100	19.23			
Lonicera							
tartarica	14.52	0.34	20	3.85			
Rosa							
woodii	130.68	3.05	80	15.38			
Shepherdia							
argentea	7.26	0.17	20	3.85			
Symphoricarpos							
occidentalis	94.38	2.20	100	19.23			

Table 31. Average number of plants, percent frequency and relative density of forbs, graminoids and seedlings in each 1-m.<sup>2</sup> in the woodland sites. - 1974 season.

Species	Woodland Sites																				
	1			2			3			4			5			6			7		
	Ave. No. of Plants M <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants M <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants M <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants M <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants M <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants M <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants M <sup>2</sup>	Ave. Freq. %	Ave. rel. den. %
<i>Acer negundo</i>	1.10	40.00	0.90	1.30	70.00	8.44	0.25	15.00	0.32				2.05	70.00	2.85	0.10	10.00	0.20	0.60	45.00	1.07
<i>Achillea millefolium</i>										0.65	15.00	0.81									
<i>Agastache foeniculum</i>																0.15	10.00	0.30			
<i>Agropyron repens</i>	4.90	30.00	4.03							6.65	50.00	8.32									
<i>Amelanchier alnifolia</i>							0.10	10.00	0.13	1.10	40.00	1.38	0.05	5.00	0.07	0.15	15.00	0.30			
<i>Amphicarpa bracteata</i>	45.89	75.00	37.71										0.30	15.00	0.42						
<i>Andropogon scoparius</i>										0.70	10.00	0.88									
<i>Anemone canadensis</i>	0.70	20.00	0.58																1.45	30.00	2.59
<i>Anemone cylindrica</i>							0.10	5.00	0.13												
<i>Antennaria parviflora</i>										2.25	20.00	2.82									
<i>Apocynum androsaemifolium</i>													0.85	45.00	1.18						
<i>Apocynum cannabinum</i>																			0.40	25.00	0.71
<i>Aquilegia canadensis</i>							0.80	30.00	1.02												
<i>Arctium minus</i>	0.10	5.00	0.08										0.05	5.00	0.07						
<i>Arenaria lateriflora</i>							0.20	5.00	0.26	0.25	5.00	0.31				0.15	5.00	0.70			
<i>Artemesia frigida</i>										0.10	5.00	0.13									
<i>Artemesia ludoviciana</i>	0.15	5.00	0.12																0.05	5.00	0.09
<i>Asclepias syriaca</i>	0.25	15.00	0.21										0.35	10.00	0.49				0.15	10.00	0.27
<i>Aster ericoides</i>										0.05	5.00	0.06									
<i>Aster laevis</i>	0.05	5.00	0.04							0.95	40.00	1.19									
<i>Aster spp.</i>										0.10	5.00	0.13									
<i>Bromus inermis</i>	7.80	20.00	6.41	0.20	75.00	1.30	30.05	75.00	38.38				8.60	40.00	11.94				3.45	40.00	6.16
<i>Calamovilfa longifolia</i>										1.30	5.00	1.63									
<i>Campanula rotundifolia</i>							0.10	5.00	0.13	1.10	30.00	1.38									
<i>Carex brevior</i>							0.10	5.00	0.13	0.15	5.00	0.19	8.65	20.00	12.01						
<i>Carex cristatella</i>																			2.45	10.00	4.37



Table 31. Continued.

Carex laeviconica	0.75	10.00	0.62										1.90	20.00	2.64				
Carex peckii				0.25	5.00	1.62	4.40	40.00	5.62	1.40	30.00	1.75	0.90	25.00	1.25	0.05	5.00	0.10	
Carex sprengelii													2.35	10.00	3.26	9.70	90.00	19.42	0.30 20.00 0.54
Carex tenera																		0.90 20.00 1.61	
Clematis ligusticifolia							0.05	5.00	0.06										
Cirsium arvense							0.05	5.00	0.06										
Comandra umbellata										0.60	10.00	0.75							
Convolvulus sepium				0.05	5.00	0.06													
Cornus stolonifera	0.05	5.00	0.04	0.05	5.00	0.32	0.05	5.00	0.06										
Crataegus chrysocarpa										0.10	5.00	0.13	0.05	5.00	0.07			0.50 25.00 0.89	
Elymus virginicus	7.45	65.00	6.12							0.20	5.00	0.25	0.70	10.00	0.97	0.20	5.00	0.40	0.90 15.00 1.61
Equisetum arvense	0.25	20.00	0.21															2.25 70.00 4.01	
Erigeron glabellus										0.15	10.00	0.19							
Euphorbia podperae	2.90	30.00	2.38				1.05	5.00	1.34										
Fragaria virginiana													5.00	85.00	6.94				
Fraxinus pennsylvanica	9.50	95.00	7.81	0.35	35.00	2.27	0.55	20.00	0.70	0.85	35.00	1.06	0.30	20.00	0.42	0.05	5.00	0.10	2.65 90.00 4.73
Galium boreale							2.25	20.00	2.87	14.55	80.00	18.21	6.45	65.00	8.96	5.90	65.00	11.81	
Galium triflorum				1.45	20.00	9.42	2.35	45.00	3.00				4.95	70.00	6.88			0.15	5.00 0.27
Geum aleppicum													0.10	10.00	0.14				
Glycyrrhiza lepidota	0.10	5.00	0.08															0.15	5.00 0.27
Hackelia deflexa							0.10	5.00	0.13										
Hedysarum boreale										0.15	5.00	0.19							
Heuchera richardsonii							0.10	10.00	0.13				0.60	30.00	0.83	0.20	10.00	0.40	
Hieraceum canadense										0.40	25.00	0.50							
Humulus lupulus				0.10	5.00	0.65	0.05	5.00	0.06	0.05	5.00	0.06							
Juniperus communis										0.45	25.00	0.56							
Lactuca oblongifolia							0.40	15.00	0.51	4.25	45.00	5.32	0.20	15.00	0.28				
Lilium philadelphicum										0.10	10.00	0.13							
Lycopus americanus																		0.10 5.00 0.18	
Lysmachia ciliata	0.35	15.00	0.29				0.05	5.00	0.06				0.05	5.00	0.07	0.10	10.00	0.20	0.15 10.00 0.27
Medicago lupulina	2.80	10.00	2.30				0.25	5.00	0.32										
Melilotus spp.	1.00	40.00	0.82															7.30 35.00 13.02	
Monarda fistulosa							1.90	25.00	2.43				1.30	25.00	1.81				
Nepeta cataria													0.55	15.00	0.76				

Oxytropis lambertii							0.70	10.00	0.89										
Oryzopsis micrantha							0.05	5.00	0.06	0.20	5.00	0.25							
Osmorhiza longistylis													1.90	55.00	2.64				
Parthenocissus vitacea	6.40	85.00	5.26	4.85	75.00	31.49	3.85	55.00	4.92				1.10	40.00	1.53	3.10	90.00	6.21	3.55 75.00 6.33
Phryma leptostachya	0.45	15.00	0.37				0.35	15.00	0.45				0.80	35.00	1.11				
Poa palustris	0.10	5.00	0.08				3.75	40.00	4.79				1.00	20.00	1.39				
Poa pratensis	7.65	10.00	6.29							10.50	20.00	13.14				0.35	5.00	0.70	
Polygonatum biflorum													0.05	5.00	0.07	0.25	10.00	0.50	
Polygonum convolvulus																		0.05	5.00 0.09
Prunus virginiana				2.05	70.00	13.31	8.95	85.00	11.43	5.05	75.00	6.32	2.75	70.00	3.82	5.10	90.00	10.21	
Rhamnus davurica													2.15	45.00	2.99				
Rhus trilobata										0.05	5.00	0.06							
Ribes americanum													0.20	15.00	0.28				
Ribes missouriense				0.40	30.00	2.60	1.10	25.00	1.40	0.05	5.00	0.06	0.25	5.00	0.35	0.05	5.00	0.10	
Rosa woodsii	0.05	5.00	0.04	0.45	30.00	2.92	0.35	15.00	0.45	0.80	35.00	1.00				0.05	5.00	0.10	0.20 15.00 0.36
Sanicula marilandica													0.10	10.00	0.14				
Senecio integerrimus										1.70	25.00	2.13							
Smilacina stellata	8.60	75.00	7.07	0.55	20.00	3.57	6.40	85.00	8.17	3.25	45.00	4.07	10.15	80.00	14.10	9.95	70.00	19.92	17.65 95.00 31.49
Smilax herbacea							0.10	5.00	0.13	0.05	5.00	0.06	0.25	15.00	0.35	1.65	50.00	3.30	
Solidago canadensis										0.45	5.00	0.56							
Solidago gigantea																0.10	5.00	0.20	2.60 55.00 4.64
Solidago rigida										2.20	35.00	2.75							
Sonchus uliginosus	3.30	30.00	2.71				1.15	25.00	1.47									2.15	40.00 3.84
Stipa viridula										0.40	5.00	0.50							
Symphoricarpos occidentalis	7.40	90.00	6.08	1.35	60.00	8.77	3.20	65.00	4.09	11.65	90.00	14.58	0.70	35.00	0.97	2.85	80.00	5.71	2.65 65.00 4.73
Taraxacum officinale	0.16	50.00	0.13	0.25	10.00	1.62	0.55	35.00	0.70	4.15	75.00	5.19	1.05	35.00	1.46				
Teucrium canadense	0.45	10.00	0.37																
Thalictrum dasycarpum				0.30	25.00	1.95	0.10	10.00	0.13										
Thalictrum venulosum	0.15	10.00	0.12										0.85	25.00	1.18	0.15	5.00	0.30	1.50 10.00 2.68
Toxicodendron radicans	0.90	10.00	0.74	1.30	40.00	8.44	1.55	20.00	1.98	0.60	5.00	0.75	1.55	30.00	2.15	0.85	40.00	1.70	0.6

Table 32. Average number of plants, percent frequency and relative density of forbs, graminoids and seedlings in each 1-M<sup>2</sup> in the woodland sites. - 1975 growing season.

Species	Woodland Sites																				
	1			2			3			4			5			6			7		
	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	Ave.	
	No. of	Freq.	rel.	No. of	Freq.	rel.	No. of	Freq.	rel.	No. of	Freq.	rel.	No. of	Freq.	rel.	No. of	Freq.	rel.	No. of	Freq.	rel.
Plants	%	den.	Plants	%	den.	Plants	%	den.	Plants	%	den.	Plants	%	den.	Plants	%	den.	Plants	%	den.	
	M <sup>2</sup>		%	M <sup>2</sup>		%	M <sup>2</sup>		%	M <sup>2</sup>		%	M <sup>2</sup>		%	M <sup>2</sup>		%	M <sup>2</sup>		%
Acer negundo	1.35	60.00	1.30	2.25	75.00	6.12	.35	20.00	.58							3.55	85.00	3.37	.85	60.00	1.66
Achillea millefolium										1.55	45.00	1.69									
Actaea rubra																			.10	10.00	.10
Agastache foeniculum							.10	5.00	.17				2.20	35.00	2.72						
Agrimonia striata							.10	5.00	.17												
Agropyron repens	2.40	37.50	2.31																		
Agropyron smithii										.50	5.00	.54									
Agropyron trachycaulum										1.75	25.00	1.90									
Allium spp.																			.10	5.00	.10
Amelanchier alnifolia				.20	10.00	.54	.65	45.00	1.08	2.50	50.00	2.72	.65	35.00	.80						
Amphicarpa bracteata	45.70	92.50	44.00													.05	5.00	.05			
Andropogon gerardi										1.30	15.00	2.06									
Andropogon scoparius																			.05	5.00	.05
Anemone canadensis	2.10	20.00	2.02							.45	10.00	.49							.70	20.00	1.36
Anemone patens										.25	10.00	.27									
Antennaria parviflora										.30	15.00	.33									
Apocynum cannabinum	.10	5.00	.10				.05	5.00	.08										.30	15.00	.58
Apocynum androsaemifolium																1.45	55.00	1.80	.05	5.00	.05
Aquilegia canadensis							.80	35.00	1.34												
Arctium minus	.05	5.00	.05													.10	10.00	.09			
Arenaria laterifolia							.20	.50	.33	.15	10.00	1.6	2.00	50.00	2.48						
Artemisia frigida										.10	5.00	.11									
Artemisia ludoviciana	.10	5.00	.10																		
Asclepias syriaca	.25	15.00	.24																.15	10.00	.29
Aster laevis				.05	5.00	.14				3.35	40.00	3.65	.20	10.00	.25						
Botrychium virginianum							.05	5.00	.08												
Bromus inermis	.03	2.50	.02																		
Bromus purgans							12.60	55.00	20.86	.05	5.00	.05				12.50	30.00	11.86			

Table 32. Continued.

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Table 32. Continued.

Lysimachia ciliata	.30	17.50	.29	.35	15.00	.95	.35	15.00	.58			.15	15.00	.19	.40	10.00	.38	.10	5.00	.20	
Medicago lupulina	.70	17.50	.67				.10	5.00	.17												
Medicago sativa	.13	2.50	.12																		
Melilotus spp.	6.50	55.00	6.26				.25	10.00	.41									4.70	30.00	9.16	
Monarda fistulosa										2.20	15.00	2.40			.15	10.00	.14				
Nepeta cataria																		2.80	30.00	2.66	
Oryzopsis micrantha										.15	10.00	.16									
Osmorhiza longistylis															4.60	60.00	4.36				
Oxalis stricta															.25	5.00	.24				
Oxytropis lambertii							.30	20.00	.98												
Parthenocissus vitacea	4.16	72.50	4.00	16.60	85.00	45.17	2.95	70.00	4.88				3.35	90.00	4.15	1.20	35.00	1.14	3.40	75.00	6.63
Parietaria pensylvanica				4.10	20.00	11.16	7.95	10.00	13.16	1.15	15.00	1.25				30.90	50.00	29.32			
Petalostemum purpureum							.25	5.00	.27												
Phryma leptostachya	.20	7.50	.19	.10	10.00	.27	.03	10.00	.50						.85	45.00	.81	.10	10.00	.20	
Plantago major				.95	20.00	2.58	.10	5.00	.17	.65	40.00	.71			2.25	60.00	2.13				
Poa palustris	.03	2.50	.02				.10	10.00	.17	3.10	45.00	3.38			.70	15.00	.66				
Poa pratensis	.73	22.50	.70							16.85	25.00	18.35									
Polygonatum biflora													1.40	40.00	1.73	.70	25.00	.66			
Polygonum convolvulus	.23	5.00	.22				.10	5.00	.17						.20	10.00	.19				
Prunus virginiana				1.85	60.00	5.03	.45	40.00	.75	4.00	70.00	4.35	1.10	50.00	1.36	.65	45.00	.62	.45	25.00	.88
Rhamnus davurica															1.20	50.00	1.14				
Ribes americanum							.20	10.00	.33												
Ribes missouriensis				.55	25.00	1.50	1.15	20.00	1.90	.05	5.00	.05	.15	15.00	.19	.10	10.00	.10			
Rosa arkansana	.13	7.50	.12																		
Rosa woodsii				.70	35.00	1.90	.45	15.00	.75	.30	45.00	.98	.15	15.00	.10			.20	15.00	.39	
Sanicula marilandica							.05	5.00	.08				1.45	10.00	1.80	.15	10.00	.14			
Senecio plattensis										.05	5.00	.05									
Sheperdia argentea										.15	5.00	.16									
Smilacina stellata	7.48	70.00	7.20	1.25	45.00	3.40	6.40	80.00	10.60	3.20	55.00	3.48	15.25	70.00	18.89	10.45	75.00	9.91	24.65	95.00	48.05
Smilax herbacea										.25	20.00	.27	1.75	60.00	2.17	.55	15.00	.52			
Solidago gigantea	.68	22.50	.65				.10	5.00	.17				.10	5.00	.12				3.05	70.00	5.95
Solidago rigida										1.45	40.00	1.58									
Sonchus uliginosus	3.65	27.50	3.51				2.20	25.00	3.64												
Sphenopholis obtusata																		.05	5.00	.05	
Stachys palustris	.43	20.00	.41															.10	5.00	.20	
Stipa viridula										.10	5.00	.11									
Symphoricarpos occidentalis	6.35	82.50	6.11	1.40	60.00	3.81	2.75	75.00	4.55	12.35	100.00	13.45	2.70	80.00	3.34	1.00	40.00	.95	2.55	14.00	4.97
Taraxacum officinale	1.45	52.59	1.40	.75	30.00	2.04	.60	35.00	.99	6.25	85.00	6.80				1.25	50.00	1.19	.10	5.00	.20

Table 32. Continued.

<i>Thalictrum dasycarpum</i>	.03	2.50	.02	.05	5.00	.14												.20	5.00	.39
<i>Thalictrum venulosum</i>	.05	5.00	.05	.40	20.00	.99						.05	5.00	.06	.95	30.00	.90	.95	15.00	1.85
<i>Toxicodendron radicans</i>	3.29	25.99	3.08	.50	25.00	1.36	3.10	30.00	5.13			4.05	45.00	5.02	2.25	25.00	2.13	.50	25.00	.98
<i>Tragopogon dubius</i>										.10	10.00	.11								
<i>Ulmus americana</i>				.15	15.00	.25						.05	5.00	.06	.85	35.00	.81			
<i>Vicia americana</i>	.48	7.50	.46				.05	5.00	.08			.15	10.00	.19				.30	10.00	.58
<i>Viola canadensis</i>										.15	5.00	.16	14.95	60.00	18.51			.70	30.00	1.36
<i>Viola nuttallii</i>										.25	10.00	.27								
<i>Viola</i> spp.	.45	25.00	.43	.05	5.00	.14														
<i>Vitis riparia</i>				.10	10.00	.27	.10	10.00	.17			.05	5.00	.06	.30	20.00	.28	.35	15.00	.68

Table 33. Average number of plants, percent frequency and relative density of forbs, graminoids and seedlings in each 1-M<sup>2</sup> in the woodland sites - 1976 season.

Species	Woodland Sites																				
	1			2			3			4			5			6			7		
	Ave. No. of Plants	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants	Ave. Freq. %	Ave. rel. den. %	Ave. No. of Plants	Ave. Freq. %	Ave. rel. den. %
<i>Acer negundo</i>	1.25	55	1.01	2.25	70	6.45	0.60	30	0.89				0.25	5	0.25	3.10	85	3.17	0.45	35	0.78
<i>Achillea millefolium</i>										0.90	30	0.96									
<i>Agastache forniculum</i>							0.10	5	0.15												
<i>Agropyron repens</i>	2.05	20	1.65				0.30	10	0.44	4.20	30	4.46									
<i>Ambrosia trifidum</i>	.10	5	.08																		
<i>Amelanchier alnifolia</i>				0.45	20	1.29	0.50	30	0.74	6.65	70	7.07	0.55	35	0.55	0.35	20	0.36	0.10	10	0.17
<i>Amphicarpa bracteata</i>	32.65	95	26.26													0.50	15	0.51	0.45	15	0.78
<i>Andropogon gerardi</i>										0.80	25	0.85									
<i>Andropogon scoparius</i>										0.25	10	0.27									
<i>Anemone canadensis</i>	.30	20	.24	0.05	5	0.14				0.05	5	0.05				0.10	5	0.10	2.80	15	4.87
<i>Anemone patens</i>										0.35	20	0.37									
<i>Anemone virginicus</i>																0.05	5	0.05			
<i>Antennaria</i> spp.										1.85	20	1.97									
<i>Apocynum androsaemifolium</i>													1.30	65	1.30						
<i>Apocynum cannabinum</i>																			0.50	35	0.87
<i>Apocynum sibiricum</i>	.15	10	.12																		
<i>Aquilegia canadensis</i>							1.35	35	1.99												
<i>Arabis hirsuta</i>										0.05	5	0.05									
<i>Arctium minus</i>																0.05	5	0.05			
<i>Arenaria lateriflora</i>													0.55	25	0.55						
<i>Asclepias syriaca</i>	.15	15	.12																0.05	5	0.09
<i>Asparagus officinalis</i>																			0.05	5	0.09
<i>Aster ericoides</i>										0.20	5	0.21									
<i>Aster laevis</i>				0.05	5	0.14				3.60	70	3.83	0.10	10	0.10	0.05	5	0.05			
<i>Bromus latiglumis</i>																11.20	35	11.47	0.30	5	0.52
<i>Bromus purgans</i>							24.40	50	36.01												
<i>Calamovilfa longifolia</i>										0.15	5	0.16									
<i>Campanula rotundifolia</i>										0.60	35	0.64									
<i>Carex brevior</i>																0.25	20	0.26	0.20	10	0.35
<i>Carex cristatella</i>																			0.15	5	0.26
<i>Carex grairda</i>																1.40	20	1.43			

Table 33, continued.

Carex laeviconica	.40	10	3.54				0.90	20	1.33	0.50	5	0.53						0.50	15	0.87
Carex peckii							1.90	30	2.80	1.30	35	1.38				0.80	30	0.82		
Carex saximontana										0.05	5	0.05				1.00	25	1.02		
Carex sprengelii													14.0	100	13.93					
Carex torreyi																0.95	15	0.97		
Celastrus scandens							7.70	60	11.37	0.05	5	0.05	10.90	75	10.85	1.35	20	1.38		
Cirsium flodmani																			0.05	5
Clematis ligusticifolia																			0.35	20
Commandra umbellata										0.25	5	0.27								
Cornus stolonifera	.05	5	.04	0.20	15	0.57													0.20	20
Crataegus chrysocarpa										0.10	10	0.11								
Cystopteris fragilis										0.05	5	0.05	0.30	15	0.30	0.95	5	0.97		
Dysporum trachycarpum										0.20	10	0.21								
Echinocystis lobata				0.05	5	0.14														
Elymus canadensis	.05	5	.04																0.75	25
Elymus virginicus	7.80	70	6.27	0.15	5	0.43	0.15	10	0.22	0.05	5	0.05	0.15	5	0.15	0.35	10	0.36	1.40	25
Equisetum arvense																			0.40	35
Erigeron strigosus										2.00	45	2.13				0.60	10	0.61		
Erysimum cheiranthoides													0.10	5	0.10	1.20	30	1.23		
Euphorbia podperae	4.35	30	3.50				0.80	10	1.18											
Fragaria americana										0.05	5	0.05				2.95	75	3.02		
Fraxinus pennsylvanica	7.35	90	5.91	0.95	50	2.72	0.25	15	0.37	1.10	40	1.17				0.05	5	0.05	3.50	80
Galium boreale							0.40	5	0.59	19.05	95	20.24	6.45	90	6.42	12.15	75	12.44		
Galium triflorum				3.80	35	10.89	2.90	50	4.28							7.05	70	7.22		
Geranium pusillum													0.30	20	0.30					
Geum aleppicum																0.20	15	0.20		
Habenaria bracteata										0.25	15	0.27								
Hackelia deflexa				0.30	15	0.86							0.25	5	0.25	0.40	40	0.92		
Helianthus rigidus																			0.05	5
Heuchera richardsonii										0.20	15	0.21	0.10	10	0.10	0.55	20	0.51		
Hieracium canadense										0.65	25	0.69								
Humulus lupulus				0.15	5	0.43														
Juniperus communis										0.35	20	0.37								
Lactuca oblongifolia							0.85	15	1.25	1.95	25	2.07				0.30	15	0.31		
Lactuca scariola																0.15	5	0.15		
Lilium philadelphicum										0.05	5	0.05								
Lonicera dioica													0.25	10	0.25					
Lysimachia ciliata	.45	5	.36	1.10	25	3.15	0.15	5	0.22				0.60	20	0.60	0.10	5	0.10	0.70	15



Table 33, continued.

Medicago lupulina	27.90	40	22.44												0.20	5	0.20							
Melilotus spp.	4.05	40	3.26	0.15	5	0.43	0.05	5	0.07						0.20	10	0.20	2.80	55	4.87				
Mentha arvensis																		0.55	5	0.96				
Monarda fistulosa										1.05	15	1.11	0.10	5	0.10	0.75	15	0.77	0.05	5	0.09			
Nepeta cataria																0.50	15	0.51						
Osmorhiza longistylis																6.35	80	6.50						
Oxalis stricta																0.65	10	0.67						
Oxytropis lambertii											0.45	15	0.49											
Parietaria pensylvanica				11.70	30	33.52	1.50	5	2.21	0.30	5	0.32			10.55	50	10.80							
Parthenocissus vitacea	5.20	85	4.18	5.25	90	15.04	2.30	55	3.39	0.15	10	0.16	2.75	75	2.74	2.00	50	2.05	4.55	85	7.91			
Petalostemum purpureum										0.05	5	0.05												
Phryma leptostachya	0.20	15	0.16				0.10	10	0.15							1.55	45	1.59	0.05	5	0.09			
Poa palustris							0.10	10	0.15	2.60	45	2.76	0.05	5	0.05	1.40	30	1.43						
Poa pratensis	3.60	45	2.90	0.10	5	0.29				12.25	20	13.02				0.75	5	0.77						
Polygonatum biflorum													0.80	35	0.80	0.70	15	0.72						
Polygonum convolvulus	0.60	20	0.48	0.05	5	0.14													0.10	5	0.17			
Prunus virginiana				1.45	65	4.15	2.05	80	3.03	3.05	65	3.24	2.05	70	2.04	1.25	45	1.28	0.10	5	0.17			
Rhamnus davurica																1.85	65	1.89						
Ribes missouriense				0.40	30	1.15	1.50	50	2.21							0.35	15	0.36						
Rosa woodsii	0.05	5	0.04	0.35	20	1.00	0.75	30	1.11	0.80	30	0.85	0.10	10	0.10	0.05	5	0.05	0.20	15	0.35			
Sanicula marilandica													1.85	15	1.84	0.80	40	0.82						
Shepherdia argentea										0.10	10	0.11							0.05	5	0.09			
Smilacina stellata	5.95	80	4.78	1.30	45	3.72	5.85	90	8.63	3.20	60	3.40	18.95	60	18.86	10.60	60	10.86	25.10	100	45.00			
Smilax herbacea										0.05	5	0.05	2.55	80	2.54	0.25	15	0.26						
Solidago canadensis										0.10	10	0.11												
Solidago gigantea	1.45	45	1.17	0.35	10	1.00	0.20	5	0.30										3.25	70	5.65			
Solidago rigida										1.65	40	1.75				0.20	5	0.20						
Sonchus arvensis																0.20	10	0.20						
Sonchus uliginosus	2.90	35	2.33	0.85	10	2.44	1.50	10	2.21										1.20	25	2.09			
Sphenopholis obtusata				0.10	5	0.29	0.40	20	0.59															
Stachys palustris	0.35	15	0.28																					
Stipa spartea										0.25	10	0.27												
Symphoricarpos																								
occidentalis	6.85	90	5.51	1.00	40	2.87	2.90	80	4.28	10.85	95	11.53	3.15	75	3.13	1.25	45	1.29	1.50	65	2.61			
Taraxacum officinale	1.10	30	0.88	0.80	30	2.29	0.65	35	0.96	7.95	75	8.45				3.90	65	3.99	0.25	15	0.43			
Thalictrum dasycarpum													0.05	5	0.05	0.05	5	0.05	0.85	15	1.48			
Thalictrum venulosum	0.20	5	0.16	0.50	35	1.43	0.15	10	0.22							0.65	35	0.67	1.20	10	2.09			
Toxicodendron radicans	2.40	20	1.93	0.80	20	2.29	4.10	30	6.05	0.50	15	0.53	16.20	45	16.12	0.95	25	0.97	0.35	10	0.61			
Tragopogon dubius	0.10	5	0.08							0.10	10	0.11												

Table 33, continued.

Ulmus americana												0.10	10		0.10	0.70	35	0.72
Urtica dioica			0.10	10	0.29													
Viburnum lentago						0.10	5	0.15										
Vicia americana						0.15	10	0.22				0.30	20	0.30				0.20 10 0.35
Viola canadensis	0.35	20	0.28	0.10	10	0.29			0.80	15	0.85	15.35	40	15.27	0.15	15	0.15	1.20 45 2.09
Vitis riparia			0.05	5	0.14	0.15	15	0.22							0.20	15	0.20	0.25 10 0.43

Appendix Table 2 gives the species obtained in the woodland sampling. It is interesting to note that 166 species representing 46 families were encountered in the woodland sampling. The common trees were cottonwood, green ash, boxelder, American elm (Ulmus americana). The most prevalent understory shrubs were Juneberry (Amelanchier alnifolia), chokecherry (Prunus virginiana), woods rose (Rosa woodsii), snowberry (Symphoricarpos occidentalis), dogwood (Cornus stolonifera), gooseberry (Ribes missouriense) and poison ivy (Toxicodendron radicans). The vines, Virginia creeper (Parthenocissus vitacea) and wild grape (Vitis riparia) are common in the woodlands. The following forbs and graminoids were common in the woodlands: Canada anemone (Anemone canadensis), blue aster (Aster laevis), brome grass (Bromis inermis), sedge (Carex brevior), sedge (Carex peckii), wildrye (Elymus virginicus), wood stickseed (Hackelia deflexa), fringed loosestrife (Lysimachia ciliata), lopseed (Phryma leptostachya), fowl bluegrass (Poa palustris), Kentucky bluegrass (Poa pratensis), wild buckwheat (Polygonum convolvulus), false Solomon's seal (Smilacina stellata), giant goldenrod (Solidago gigantea), dandelion (Taraxacum officinale), tall meadowrue (Thalictrum dasycarpum), early meadowrue (Thalictrum venulosum), wild vetch (Vicia americana) and wood violet (Viola candensis).

#### Summary

Five prairie sites and seven woodland sites were studied to obtain baseline data that can be used in the future to monitor the possible long-term effects of emissions from two coal-fired electrical generating plants. The study sites were located in the direction of the prevailing winds in order to have typical plant communities exposed to maximum emissions over time.

It is important to point out that at the present time there were no observable injuries due to emissions noted.

The feeling of our study team is that it will be extremely worthwhile to re-sample the same study sites 5, 10 and 15 years from now to determine the status of the same plant communities then. There will be additional influences of coal development by then and one will have to keep successional changes in mind as these sites are monitored in the future. This study was important because the baseline now exists so that future monitoring of these sites is possible.



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Appendix Table 1. List of taxa obtained in sampling of prairie vegetation.

Graminoids

<u>Species</u>	<u>Family</u>	<u>Prairie Sites</u>				
		1	2	3	4	5
Agrohordeum macounii	Gramineae			✓		✓
Agropyron smithii	Gramineae	✓	✓	✓	✓	
Andropogon gerardi	Gramineae		✓		✓	
Andropogon scoparius	Gramineae			✓	✓	✓
Aristida longiseta	Gramineae			✓		✓
Bouteloua curtipendula	Gramineae					✓
Bouteloua gracilis	Gramineae	✓	✓	✓	✓	✓
Calamagrostis montanensis	Gramineae		✓			
Carex eleocharis	Cyperaceae	✓				✓
Carex filifolia	Cyperaceae	✓	✓	✓	✓	✓
Carex heliophila	Cyperaceae	✓	✓		✓	✓
Koeleria pyramidata	Gramineae	✓	✓	✓	✓	✓
Muhlenbergia cuspidata	Gramineae				✓	✓
Poa secunda	Gramineae	✓				
Stipa comata	Gramineae	✓	✓	✓	✓	✓
Stipa viridula	Gramineae		✓		✓	✓

Forbs and Shrubs

Achillea millefolium	Compositae			✓		
Agoseris glauca	Compositae		✓			
Allium textile	Liliaceae		✓		✓	
Ambrosia artemisiifolia	Compositae	✓				
Androsace occidentalis	Primulaceae		✓	✓		
Anemone patens	Ranunculaceae				✓	✓
Arabis hirsuta	Cruciferae					✓
Arabis holboellii	Cruciferae	✓			✓	
Artemisia absinthium	Compositae					✓
Artemisia campestris	Compositae	✓				✓
Artemisia caudata	Compositae	✓	✓			
Artemisia dracunculus	Compositae	✓	✓		✓	✓
Artemisia frigida	Compositae	✓	✓		✓	✓
Asclepias stenophylla	Asclepiadaceae	✓				
Aster ericoides	Compositae	✓	✓	✓	✓	✓
Astragalus spp.	Leguminosae					✓
Camelina microcarpa	Cruciferae	✓				
Castilleja sessiliflora	Scrophulariaceae	✓				
Ceratoides lanata	Compositae					✓
Chenopodium album	Chenopodiaceae		✓			
Chenopodium leptophyllum	Chenopodiaceae	✓	✓	✓	✓	✓
Cirsium undulatum	Compositae					✓
Collomia linearis	Polemoniaceae		✓			
Coryphantha vivipara	Cactaceae		✓			
Commandra umbellata	Santalaceae				✓	✓



## Appendix Table 1, continued.

Forbs and Shrubs, continued.

<u>Species</u>	<u>Family</u>	<u>Prairie Sites</u>				
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Draba nemorosa	Cruciferae			✓		
Echinacea angustifolia	Compositae		✓		✓	✓
Erigeron glabellus	Compositae		✓		✓	
Erigeron strigosus	Compositae			✓		
Erysium asperum	Cruciferae		✓			
Euphorbia glyptosperma	Euphorbiaceae		✓			
Gaura coccinea	Onagraceae	✓	✓	✓		✓
Grindelia squarrosa	Compositae		✓		✓	✓
Gutierrezia sarothrae	Compositae					✓
Haplopappus spinulosus	Compositae		✓		✓	✓
Hedeoma hispida	Labiatae	✓	✓	✓	✓	✓
Hedysarum boreale	Leguminosae					✓
Helianthus petiolaris	Compositae		✓			
Lactuca oblongifolius	Compositae	✓	✓	✓	✓	✓
Lappula redowskii	Boraginaceae	✓	✓			✓
Lepidium densiflorum	Cruciferae	✓	✓	✓		✓
Lesquerella arenosa	Cruciferae		✓			✓
Liatris punctata	Compositae	✓	✓		✓	✓
Linum rigidum	Linaceae	✓	✓	✓	✓	✓
Lithospermum incisum	Boraginaceae		✓	✓		
Lomatium foeniculaceum	Umbelliferae		✓			
Lygodesmia juncea	Compositae	✓		✓	✓	✓
Medicago sativa	Leguminosae			✓		
Melilotus officinalis	Leguminosae		✓		✓	
Monarda fistulosa	Labiatae				✓	
Orthocarpus luteus	Scrophulariaceae		✓		✓	✓
Paronychia sessiliflora	Caryophyllaceae				✓	✓
Penstemon albidus	Scrophulariaceae					✓
Petalostemum purpureum	Leguminosae				✓	✓
Phlox hoodii	Polemoniaceae		✓		✓	✓
Plantago patagonica	Plantaginaceae		✓			
Polygala alba	Polygalaceae	✓	✓	✓	✓	✓
Polygonum convolvulus	Polygonaceae					✓
Potentilla pensylvanica	Rosaceae			✓	✓	✓
Psoralea argophylla	Leguminosae	✓	✓	✓	✓	✓
Psoralea esculenta	Leguminosae					✓
Ratibida columnifera	Compositae	✓	✓		✓	
Rosa arkansana	Rosaceae		✓			
Senecio plattensis	Compositae				✓	✓
Solidago missouriensis	Compositae					✓
Solidago mollis	Compositae				✓	
Solidago rigida	Compositae	✓				✓
Sphaeralcea coccinea	Malvaceae	✓	✓	✓	✓	✓
Symphoricarpos occidentalis	Caprifoliaceae				✓	
Taraxacum officinale	Compositae	✓	✓	✓	✓	✓
Tragopogon dubius	Compositae	✓	✓	✓	✓	✓
Vicia americana	Leguminosae		✓		✓	✓
Viola nuttallii	Violaceae	✓	✓		✓	✓



Appendix Table 2. List of taxa obtained in sampling woodland vegetation.

<u>Species</u>	<u>Family</u>	<u>Woodland Sites</u>						
<u>Trees, shrubs and vines:</u>		1	2	3	4	5	6	7
<i>Acer negundo</i>	Aceraceae	✓	✓	✓		✓	✓	✓
<i>Amelanchier alnifolia</i>	Rosaceae		✓	✓	✓	✓	✓	✓
<i>Cornus stolonifera</i>	Cornaceae		✓	✓			✓	✓
<i>Crataegus chrysocarpa</i>	Rosaceae			✓		✓		
<i>Eleagnus angustifolius</i>	Eleagnaceae	✓	✓					
<i>Fraxinus pensylvanica</i>	Oleaceae	✓	✓	✓	✓	✓	✓	✓
<i>Juniperus communis</i>	Cupressaceae			✓	✓			
<i>Lonicera tatarica</i>	Caprifoliaceae	✓	✓					
<i>Parthenocissus vitacea</i>	Vitaceae							✓
<i>Populus deltoides</i>	Salicaceae	✓	✓	✓	✓			✓
<i>Prunus americana</i>	Rosaceae					✓	✓	
<i>Prunus virginiana</i>	Rosaceae	✓	✓	✓	✓	✓	✓	
<i>Rhamnus davurica</i>	Rhamnaceae					✓	✓	
<i>Rhus trilobata</i>	Anacardiaceae				✓			
<i>Rosa woodsii</i>	Rosaceae		✓	✓	✓	✓		✓
<i>Salix amygdaloides</i>	Salicaceae		✓					
<i>Shepherdia argentea</i>	Elaeagnaceae				✓		✓	
<i>Symphoricarpos occidentalis</i>	Caprifoliaceae			✓	✓	✓	✓	✓
<i>Ulmus americana</i>	Ulmaceae			✓	✓	✓	✓	
<i>Viburnum lentago</i>	Caprifoliaceae			✓	✓		✓	
<i>Vitis riparia</i>	Vitaceae					✓		
<u>Forbs, graminoids and seedlings:</u>								
<i>Acer negundo</i>	Aceraceae	✓	✓	✓		✓	✓	✓
<i>Achillea millefolium</i>	Compositae				✓			
<i>Actaea rubra</i>	Ranunculaceae							✓
<i>Agastache foeniculum</i>	Labiatae			✓		✓	✓	
<i>Agrimonia striata</i>	Rosaceae			✓				
<i>Agropyron repens</i>	Gramineae	✓		✓	✓			
<i>Agropyron smithii</i>	Gramineae				✓			
<i>Agropyron trachycaulum</i>	Gramineae				✓			
<i>Allium sp.</i>	Lilaceae							✓
<i>Ambrosia trifidum</i>	Compositae	✓						
<i>Amelanchier alnifolia</i>	Rosaceae		✓	✓	✓	✓	✓	✓
<i>Amphicarpa bracteata</i>	Leguminosae	✓				✓	✓	✓
<i>Andropogon gerardi</i>	Gramineae				✓			
<i>Andropogon scoparius</i>	Gramineae				✓			✓
<i>Anemone canadensis</i>	Ranunculaceae	✓	✓		✓		✓	✓
<i>Anemone cylindrica</i>	Ranunculaceae			✓				
<i>Anemone patens</i>	Ranunculaceae				✓			
<i>Anemone virginicus</i>	Ranunculaceae						✓	
<i>Antennaria parviflora</i>	Compositae				✓			
<i>Antennaria spp.</i>	Compositae				✓			
<i>Apocynum androsaemifolium</i>	Apocynaceae					✓	✓	✓
<i>Apocynum cannabinum</i>	Apocynaceae	✓		✓				✓
<i>Apocynum sibiricum</i>	Apocynaceae	✓						
<i>Aquilegia canadensis</i>	Ranunculaceae			✓				
<i>Arabis hirsuta</i>	Cruciferae				✓			
<i>Arctium minus</i>	Compositae	✓				✓	✓	
<i>Arenaria lateriflora</i>	Caryophyllaceae			✓	✓	✓	✓	

Appendix Table 2, continued.

<u>Species</u>	<u>Family</u>	<u>Woodland Sites</u>						
<u>Forbs, graminoids and seedlings, continued:</u>		1	2	3	4	5	6	7
<i>Artemisia frigida</i>	Compositae				✓			
<i>Artemisia ludoviciana</i>	Compositae	✓						✓
<i>Asclepias syriaca</i>	Asclepidaceae	✓				✓		✓
<i>Asparagus officinalis</i>	Liliaceae							✓
<i>Aster ericoides</i>	Compositae				✓			
<i>Aster laevis</i>	Compositae	✓	✓		✓	✓	✓	
<i>Aster</i> spp.	Compositae				✓			
<i>Botrychium virginianum</i>	Ophioglossaceae			✓				
<i>Bromus inermis</i>	Gramineae	✓	✓	✓		✓		✓
<i>Bromus latiglumis</i>	Gramineae						✓	✓
<i>Bromus purgans</i>	Gramineae			✓	✓		✓	
<i>Calamovilfa longifolia</i>	Gramineae				✓			
<i>Campanula rotundifolia</i>	Campanulaceae			✓	✓			
<i>Carex brevior</i>	Cyperaceae	✓		✓	✓	✓	✓	✓
<i>Carex cristatella</i>	Cyperaceae							✓
<i>Carex gravida</i>	Cyperaceae	✓					✓	
<i>Carex laeviconica</i>	Cyperaceae	✓		✓	✓	✓	✓	✓
<i>Carex peckii</i>	Cyperaceae		✓	✓	✓	✓	✓	
<i>Carex saximontana</i>	Cyperaceae				✓	✓	✓	
<i>Carex sprengei</i>	Cyperaceae				✓	✓	✓	✓
<i>Carex tenera</i>	Cyperaceae							✓
<i>Carex torreyi</i>	Cyperaceae						✓	
<i>Carex</i> spp.	Cyperaceae					✓		✓
<i>Celastrus scandens</i>	Celastraceae			✓	✓	✓	✓	
<i>Cirsium arvense</i>	Compositae			✓				
<i>Cirsium flodmani</i>	Compositae							✓
<i>Clematis ligusticifolia</i>	Ranunculaceae	✓		✓				✓
<i>Convolvulus sepium</i>	Convolvulaceae			✓				
<i>Commandra umbellata</i>	Santalaceae				✓			
<i>Cornus stolonifera</i>	Cornaceae	✓	✓	✓				✓
<i>Crataegus chrysocarpa</i>	Rosaceae				✓	✓		
<i>Crepis runcinata</i>	Compositae				✓			
<i>Cystopteris fragilis</i>	Polypodiaceae			✓	✓	✓	✓	
<i>Disporum trachycarpum</i>	Liliaceae				✓			
<i>Echinacea angustifolia</i>	Compositae				✓			
<i>Echinocystis lobata</i>	Cucurbitaceae		✓				✓	
<i>Elymus canadensis</i>	Gramineae	✓			✓			✓
<i>Elymus virginicus</i>	Gramineae	✓	✓	✓	✓	✓	✓	✓
<i>Equisetum arvense</i>	Equisetaceae	✓						✓
<i>Erigeron glabellus</i>	Compositae				✓			
<i>Erigeron strigosus</i>	Compositae				✓		✓	
<i>Erysimum asperum</i>	Cruciferae							✓
<i>Erysimum chieranthoides</i>	Criciferae		✓	✓		✓	✓	
<i>Euphorbia podperae</i>	Euphorbiaceae	✓		✓				
<i>Fragaria americana</i>	Rosaceae	✓			✓		✓	
<i>Fragaria virginiana</i>	Fosaceae				✓	✓		
<i>Fraxinus pensylvanica</i>	Oleaceae	✓	✓	✓	✓	✓	✓	✓

Appendix Table 2, continued.

<u>Species</u>	<u>Family</u>	<u>Woodland Sites</u>						
<u>Forbs, graminoids and seedlings, continued:</u>		1	2	3	4	5	6	7
Galium boreale	Rubiaceae			✓	✓	✓	✓	
Galium triflorum	Rubiaceae		✓	✓		✓	✓	✓
Geranium carolinianum	Geraniaceae					✓		
Geranium pusillum	Geraniaceae					✓		
Geum aleppicum	Rosaceae					✓	✓	
Glycyrrhiza lepidota	Leguminosae	✓		✓				✓
Habenaria bracteata	Orchidaceae				✓			
Hackelia deflexa	Borraginaceae	✓	✓	✓		✓	✓	
Hedysarum boreale	Leguminosae				✓			
Helianthus rigidus	Compositae							✓
Heuchera richardsonii	Saxifragaceae			✓	✓	✓	✓	
Hieracium canadense	Compositae				✓			
Humulus lupulus	Moraceae		✓	✓	✓			
Juniperus communis	Cupressaceae				✓			
Lactuca oblongifolia	Compositae			✓	✓	✓	✓	
Lactuca scariola	Compositae						✓	✓
Lilium philadelphicum	Liliaceae				✓			
Lonicera dioica	Caprifoliaceae					✓	✓	
Lycopus americanus	Labiatae							✓
Lysimachia ciliata	Primulaceae	✓	✓	✓		✓	✓	✓
Medicago lupulina	Leguminosae	✓		✓			✓	
Medicago sativa	Leguminosae	✓						
Melilotus spp.	Leguminosae	✓	✓	✓			✓	✓
Mentha arvensis	Labiatae							✓
Monarda fistulosa	Labiatae			✓	✓	✓	✓	
Nepeta catarica	Labiatae					✓	✓	✓
Orysopsis micrantha	Gramineae			✓	✓			
Osmorhiza longistylis	Umbelliferae					✓	✓	
Oxalis stricta	Oxalidaceae						✓	
Oxytropis lambertii	Leguminosae			✓	✓			
Parietaria pensylvanica	Urticaceae		✓	✓	✓		✓	
Parthenocissus vitacea	Vitaceae	✓	✓	✓		✓	✓	✓
Petalostemum purpureum	Leguminosae				✓			
Phyrma leptostachya	Phyrmeaceae	✓	✓	✓		✓	✓	✓
Plantago major	Plantaginaceae		✓	✓	✓		✓	
Poa palustris	Gramineae	✓		✓	✓	✓	✓	
Poa pratensis	Gramineae	✓	✓		✓		✓	
Polygonatum biflorum	Liliaceae					✓	✓	
Polygonum convolvulus	Polygonaceae	✓	✓	✓			✓	✓
Prunus virginiana	Rosaceae		✓	✓	✓	✓	✓	✓
Rhamnus davurica	Rhamnaceae					✓	✓	
Rhus trilobata	Anacardiaceae				✓			
Ribes americanum	Saxifragaceae			✓		✓		
Ribes missouriense	Saxifragaceae		✓	✓	✓	✓	✓	
Rosa arkansana	Rosaceae	✓						
Rosa woodsii	Rosaceae	✓	✓	✓	✓	✓	✓	✓
Sanicula marilandica	Umbelliferae			✓		✓	✓	
Senecio integerrimus	Compositae				✓			
Senecio plattensis	Compositae				✓			



Appendix Table 2, continued.

<u>Species</u>	<u>Family</u>	<u>Woodland Sites</u>						
<u>Forbs, graminoids and seedlings, continued:</u>		1	2	3	4	5	6	7
Sheperdia argentea	Elaeagnaceae				✓			✓
Smilacina stellata	Liliaceae	✓	✓	✓	✓	✓	✓	✓
Smilax herbacea	Liliaceae			✓	✓	✓	✓	
Solidago canadensis	Compositae				✓			
Solidago gigantea	Compositae	✓	✓	✓		✓	✓	✓
Solidago rigida	Compositae				✓		✓	
Sonchus arvensis	Compositae						✓	
Sonchus uliginosus	Compositae	✓	✓	✓				✓
Sphenopholis obtusata	Gramineae		✓	✓				✓
Stachys palustris	Labiatae	✓						✓
Stipa spartea	Gramineae				✓			
Stipa viridula	Gramineae				✓			
Symphoricarpos occidentalis	Caprifoliaceae	✓	✓	✓	✓	✓	✓	✓
Taraxacum officinale	Compositae	✓	✓	✓	✓	✓	✓	✓
Teucrium canadense	Labiatae	✓						
Thalictrum dasycarpum	Ranunculaceae	✓	✓	✓		✓	✓	✓
Thalictrum venulosum	Ranunculaceae	✓	✓	✓		✓	✓	✓
Toxicodendron radicans	Anacardiaceae	✓	✓	✓	✓	✓	✓	✓
Tragopogon dubius	Compositae	✓			✓			
Ulmus americana	Ulmaceae		✓	✓	✓	✓	✓	
Urtica dioica	Urticaceae		✓					
Viburnum lentago	Caprifoliaceae			✓				
Vicia americana	Leguminosae	✓		✓		✓	✓	✓
Viola canadensis	Violaceae	✓	✓	✓	✓	✓	✓	✓
Viola nuttallii	Violaceae				✓			
Viola spp.	Violaceae	✓	✓					✓
Vitis riparia	Vitaceae		✓	✓		✓	✓	✓